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The Copper and Tin Deposits of Katanga

Remarkable Deposits in the Congo Are Being Developed, and Will Be Largely Productive When Railway Communication Is Available

BY JOHN R. FARRELL*

Katanga is the southeastern division of the Congo Free State and the portion about the headwaters of the Lualaba and Lufira rivers, the center of the northern slope of the Congo-Zambesi watershed, is known as Upper, or Haut Katanga, whence the name of the company to which title to the mineral belts has been granted—Union Minière Du Haut Katanga. This is a Congolese limited liability company with head offices in Brussels, Belgium, organized with 100,000 dividend shares, having no described value, issued in consideration of work done, 60 per cent. to the Katanga Special Committee of Brussels, and 40 per cent. to Tanganyika Concessions, Ltd., of London; and also 100,000 capital shares of 100 francs ($20) each; 50,000 shares subscribed by the Société Generale de Belgique and 50,000 shares by Tanganyika Concessions. None of the shares are negotiable until after the company has issued its third annual financial statement and the Tanganyika Concessions' holdings, except 2000 shares reserved to commute prospectors' rights, are pledged as part of the security on its issue of $10,000,000 of 5 per cent. bonds.

The properties held by the company are those which have attracted great and increasing attention during the past five years, and the only way now to secure interest in them is through Tanganyika Concession issues.

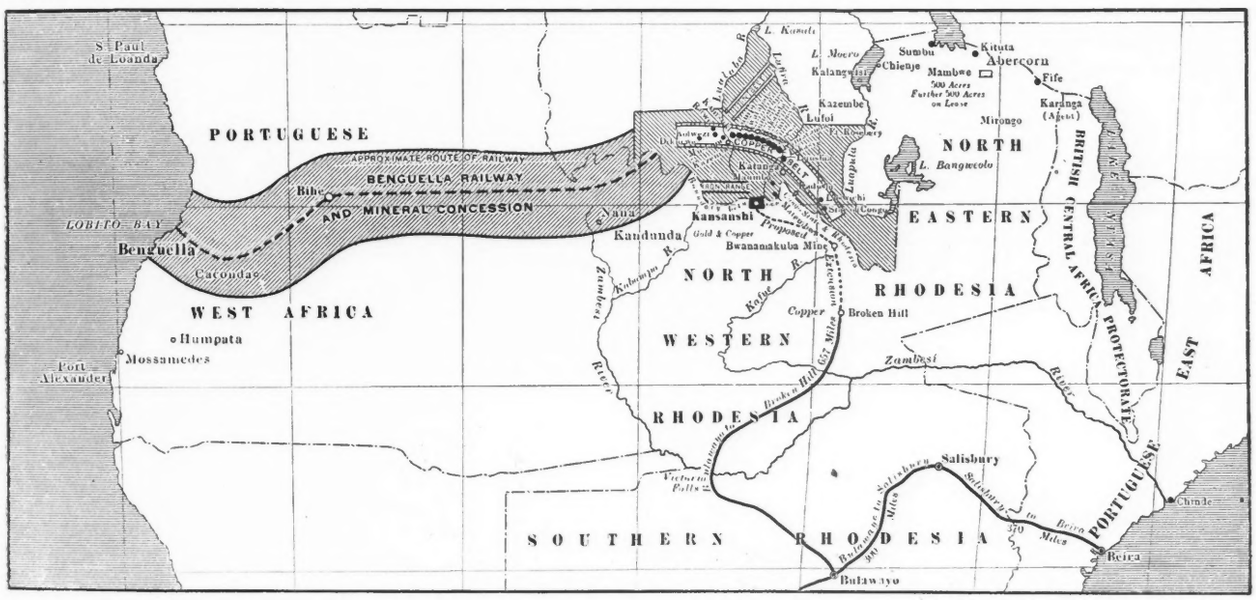
Properties of the Company

The grants to the company are enormous, comprising all the copper beds, without exception, in the copper belt; all the tin beds, without exception, in the tin belt; the Ruwe gold mine, the iron beds and generally all the mining beds discovered by Tanganyika Concessions before Dec. 9, 1906, and also the most complete rights to use the necessary resources of the country for the working of the mines. There is, therefore, little of mining value left for anyone else within the limits of the original concession.

There are three distinct mineral belts, containing, respectively, deposits of iron, copper and tin.

The principal iron belt is close to and along the watershed in a ferriferous sandstone country, containing also large areas of dolomitic limestone. The iron ore is found outcropping in hills from 50 to 200 ft. in hight. Little or no attempt has been made to ascertain its limits. It has been looked at solely for the purpose of determining its suitability for fluxing silicious copper ores, and has been found excellent. The quantity exposed above the country level runs into millions of tons; and while some of it is schistose with considerable silica, there are also hills of hematite, limonite and magnetite containing from 64 to 66 per cent. iron of sufficient extent to supply such material for years. In the distant future, when Central Africa may become a busy land, this belt may be of value for its iron; but until then its only use is as flux. Near the copper mines are some narrow persistent runs of hematite and at places, Kambove for instance, valuable deposits of limonite are found close to the copper.

The copper belt is the important one of Katanga. Commencing at about meridian 28-East, between parallels 11 and 12-South it extends for nearly 200 miles toward the northwest, and in this distance over one hundred known outcropping copper mines are located upon each of which natives have worked. Nothing has been done to open new orebodies, for the known quantity is ample for years ahead. The natives must have been at



KATANGA COPPER DISTRICT, CONGO, CENTRAL AFRICA

*Mining engineer, San Francisco, Cal. Late head engineer of Tanganyika Concessions, Ltd.

work many centuries, perhaps back into the days of the Pharaohs, for the amount is enormous and they have progressed so far in the treatment of copper as not only to make spears, axes, hoes, rings, etc., but also fine-drawn copper wire which is in use in Central Africa for ornament.

Nature of the Copper Deposits

While the mines vary in size and grade there is a marked similarity of ore occurrence throughout, and this is of an unusual, even unique, character. There is no gossan, no overlay, no barren zone; the ore comes in strength to the surface as high-grade oxidized copper ores—a little chrysocolla, a little azurite, but almost entirely malachite in which the natives sank their thousands of little well-like shafts and also at times made large excavations.

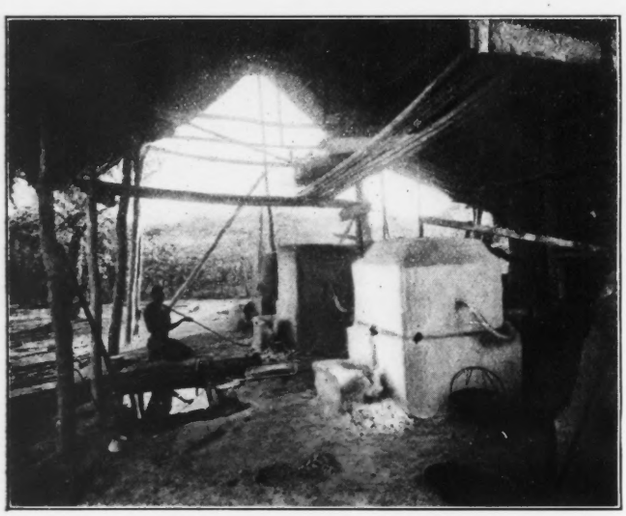
Over these deposits the ground is bare while the rest of the country is green with woods, so, once being in the district, there was no more trouble to find copper mines than to pick out bald heads in a theater. Further, there is no evidence that these ores resulted from alteration of sulphides *in situ*, and with the exception of one piece of chalcopyrite picked up on an old dump at the Luushia mine in 1902 I have never seen a bit of sulphide copper ore from Katanga.

There is upon each mine a wide core of what is termed "porous quartz ore" and on each side of this is found a wide layer of "laminated sandstone ore," these terms being used merely to designate materials. In the porous quartz ore, malachite is found in the vugs and seams while the rock itself is barren and as a result this material lends itself well to cheap hand sorting to eliminate a large portion of its silica excess. In the laminated ore, seams and fine threads of malachite are ribboned with equally fine seams of the matrix which, generally, is itself also impregnated and does not admit of much mechanical enrichment.

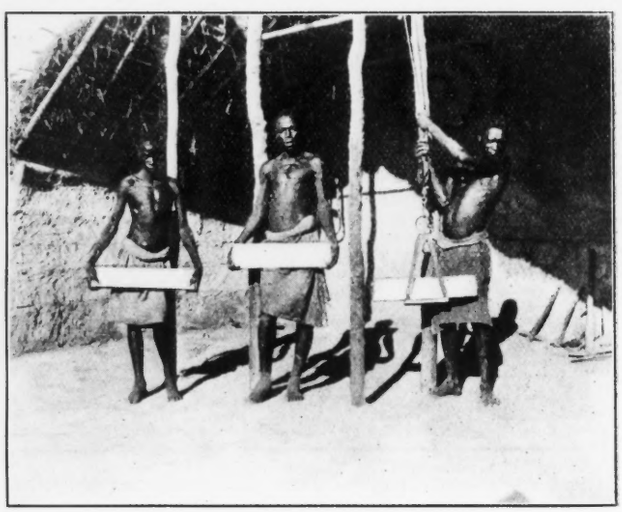
Except in about 40 miles between the rivers Dikulwe and Lualaba and in the Dikurwe area at the extreme west where the quartz ore is poor, there is little, if any, difference of grade in the two varieties of materials. Although statements may have been made to the contrary, there is no evidence to my knowledge showing any fading away of value toward the edges of the layers, the ore holding up in grade clear across to the barren country rock; but different strata within the orebodies vary much in copper contents, this variation not depending upon the location of the strata with reference to the outside rock.

KOLWEZI COPPER SMELTERY—ALL APPARATUS "HOME MADE"

COPPER BARS AT KOLWEZI



TIN SMELTERY, BUSANGA



TIN FROM BUSANGA MINE

Extent of the Orebodies.

As to the width of the orebodies the following statement is taken from the prospectus filed with the Registrar of Joint Stock Companies in London in November, 1906, when Tanganyika Concessions made a public issue of $10,000,000 5-per cent. debentures, the whole of which were underwritten: "Copper—In the western half of the copper belt, that is in the section lying to the west of the

Lufira river, 26 crosscut tunnels have been run in ten of the deposits, giving average backs of about 100 ft., which will give a sufficient mining tonnage for a great number of years. These tunnels have exposed widths of ore as follows: Kabolela area, two tunnels, 46 and 57 ft.; Kakanda area, two tunnels, 130 to 150 ft.; Fungurume area, two tunnels, 120 ft., one tunnel, 130 ft., orebody not cut through; Kwatabala area, six tunnels, 20 to 40 ft.; Pumpi area, one tunnel, 60 ft.; Musonoi area, two tunnels, 190 and 242 ft.; Dikurwe area, three tunnels, 70 ft.; Kolwezi area, one tunnel, 258 ft., orebody not cut through; Likasye area, one tunnel, 373 ft., orebody not cut through; Kambove area, five tunnels showing great widths of ore, the longest being 401 ft., with orebody not cut through.

"On each of these areas the orebodies show on the surface being generally covered by native pits. On June 8, 1905, the official engineer of the Congo Free State, who spent over 18 months in the district during the time these developments were being made reported there was shown ore containing two million tons of copper. The engineers of the company have also examined the work and reported similar results."

Grade of the Ore

The group of mines mentioned between the Lualaba and Dikulwe rivers run from 6 to 8 per cent. copper, with 50 to 60 per cent. silica excess, and are out of consideration at present. However, as they contain millions of tons of such ore which can be largely quarried and with fine running streams right at hand, it is very certain that in the future, as occasion requires, methods will be worked out for their profitable treatment.

On the remaining properties, while the grade varies, there should be little difficulty in maintaining for years an average of from 12 to 15 per cent. Three of these have had special consideration because of their size and location: Star of the Congo at the extreme eastern end, which would be the mine operated in case, which is probable, the Rhodesian (Cape to Cairo) railroad from the south was first to supply the needed transport; Kambove, the premier mine of the belt, near the center, and Kolwezi at the extreme west end where the Benguella railway will enter.

The Star of the Congo is about 40 miles from the Rhodesian frontier in a flat country where shafts would be necessary. Five prospect shafts have been sunk showing the mine to be divided into two parts, of which the northwestern is the more important. Here three crosscut tunnels give an average width of 96 ft. of high-grade ore for a length of 2000 ft., or, so long as it holds, about 1,250,000 tons for each 100 ft. in depth, and some of the shafts are deeper than 100 ft. The ore lies in four parallel adjoining longitudinal layers with characteristics and contents as shown in the accompanying table.

ANALYSES OF ORES FROM THE STAR OF THE CONGO MINE.

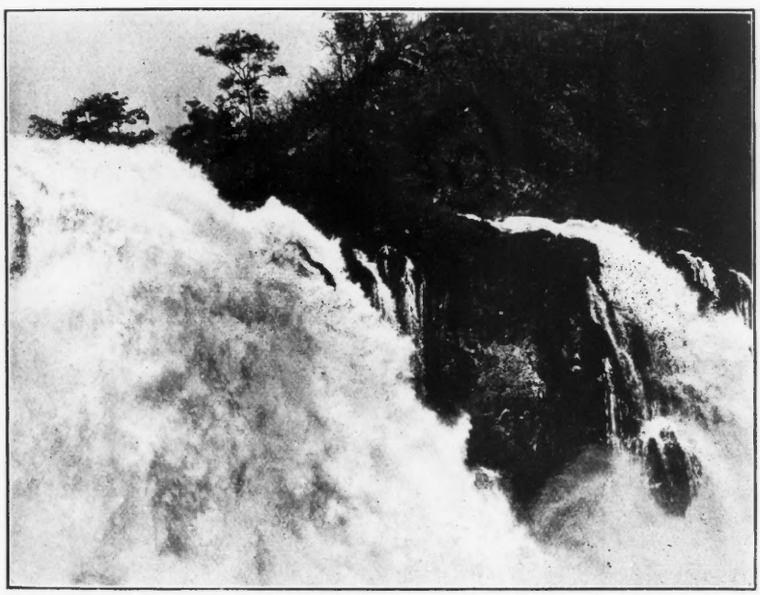
	Quartzose. Per Cent.	Sandstone. Per Cent.	Shaly. Per Cent.	Manganiferous. Per Cent.
Copper	9.93	7.66	17.91	18.04
Iron	3.89	3.23	4.75	5.22
Nickel and Cobalt	1.67	1.43	1.64	3.15
Manganese	0.35	0.25	0.15	0.76
Lime	1.90	2.34	0.75	1.06
Magnesia	2.64	6.08	14.38	2.04
Alumina	4.67	4.01	11.25	8.81
Moisture	2.00	2.55	3.10	3.55
Silica	64.00	64.85	28.30	39.08
Carbon Dioxide	3.70	4.24	6.30	8.45
Combined Water, Oxygen and Loss	4.65	3.36	11.47	9.84

Sorting tests have also been made, using native labor, and it has been found that for from 10 to 20c. per ton much of the silica can be eliminated and the greater portion of the mine can be made to yield a high-grade nearly self-fluxing ore. Limestone occurs at the mine.

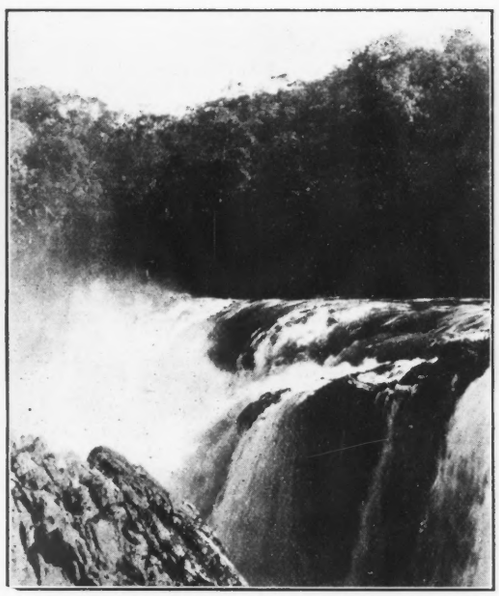
Kambove, near the center of the belt, shows an astonishing body of high-grade ore. It lies in a swale between rounded hills sloping toward Livingstone creek from which it can be worked open-cast. The main orebody, which courses east and west with dip to the north, is exposed for a length of nearly 3000 ft., but the western 1500 ft., where the natives sank their little pits, has been the only portion opened. Here seven shafts have been sunk to the 100-ft. level and five crosscuts extended from them, no one of which at my last account had reached any limit of the orebearing ground. The most westerly crosscut shows 239 ft. of ore, of which 172 ft. is high-grade. The most easterly cut is 297 ft. long, of which 96 ft. is high-grade. Between these extremes the other three cuts show great width of beautiful ore, the longest being 401 ft. in first-class material for the full distance and both faces in solid ore.

Millions of tons can be quarried at this mine, and by care with easy sorting a product averaging 15 per cent. copper and from 20 to 30 per cent. free silica can be sent out for treatment. Large bodies of limonite and limestone are close at hand. From the ravine of Livingstone creek which cuts across the area 180 oz. of coarse gold was cleaned up which could come only from this mine.

Kolwezi to the west is also a large and very attractive property extending to the edge of a delightful stream. It lies along the side of a low hill all over which the natives have worked for a length of 1500 ft., and while the ore narrows at each



BUSANGA FALLS, LUALABA RIVER



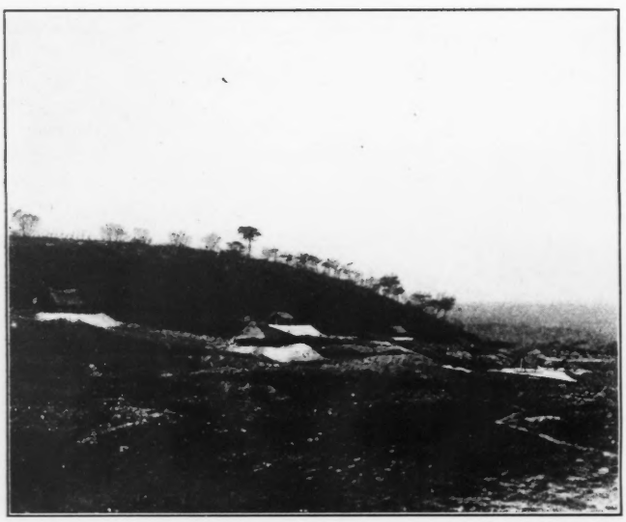
NZILIO FALLS, LUALABA RIVER

end of the lens, for a distance of about 800 ft. it is fully 400 ft. in width. One of the native works is a trench more than 1000 ft. long, 15 ft. wide and 10 ft. deep, all in ore. From a little shaft sunk 10 ft. deep in this trench a crosscut has been run south exposing 258 ft. of high-grade ore, and there is about as much more lying to the north.

Last season a bore hole was put down 127 ft. below this tunnel level and cut with regularity the strata outcropping with their dip to the north. The Kol-

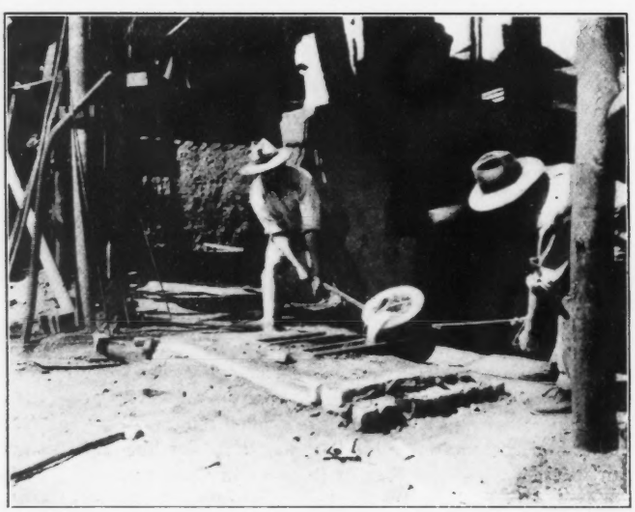
and unsuitable for water concentration. Still, so cheap is the mining and so high-grade the ore of mines like those described, that copper should be turned out at an exceedingly low cost for actual production of metal. In 1902 my estimate was that, given adequate transport and a suitable central reduction plant, copper should be made at a cost of £12 ($60) per ton. The specialist now in charge for the Union Minière has reported that he will be able to treat the ore at a cost not to exceed £10 ($50) per ton of copper and the

ply, and it is upon that basis that operations are outlined. The installation for such purpose would be neither extensive nor expensive for concentrators, roasters, forehearths and converters would be useless and great water power is available. The questions of handling the molten copper would be similar to those in the blast furnaces on Lake Michigan, and the two or three per cent. going as grains in the slag would be no greater in proportion to grade than is the loss in most concentration plants.



PORTION OF KAMBOVE—ALL BARE GROUND IS COPPER OUTCROP

NATIVE TRENCH, KOLWEZI COPPER MINE—ORE FULL WIDTH OF TRENCH



CASTING COPPER FROM GALVANIZED-IRON BUCKET LINED WITH CLAY

OUTCROP OF STAR OF THE CONGO MINE—BARE GROUND IS ORE

wezi, as it stands, is easily a 15 per cent. mine and by a little sorting the ore can be kept under 30 per cent. free silica. At this mine fully 50 tons of copper bars were turned out with the plant shown in accompanying illustrations.

Treatment Problem

The fluxes in the country are all or nearly all barren; the ore carries precious metals only in quantities too small to be of commercial value and it is all oxidized

same figure was arrived at last year by the Australian engineer sent out in behalf of the debenture holders. The ores carry no bismuth, arsenic, antimony, lead, zinc or any of the base metals.

No doubt now remains as to these ores being readily smelted to black copper at one operation in water jacket furnaces constructed for the treatment of copper carbonates. The present idea is to smelt 3000 tons of 15 per cent. ore daily, an amount the belt can steadily sup-

Other Methods Proposed

Meantime, investigations are also proceeding looking to other methods of treatment, and at present these are along two lines: (1) Electric smelting; tests made on the ores by Professor Eric Gerard at his works at Ugine, Savoie, Switzerland, gave encouraging results and the facilities for such operation in Katanga are exceptional. The large rivers flow northerly, cutting across the mineral zones, and as the country falls off in benches water power


MAP OF THE
UNION MINIÈRE DU HAUT KATANGA COPPER AREA
Showing
COPPER, IRON & DOLOMITE DEPOSITS
COPPER
IRON
DOLOMITE
Kambove
Mutumbwana
South Latitude
Longitude East 27° of Greenwich

is available at several places. The largest available falls are on the Lualaba river where from the Nzilio to the Busanga falls, along a distance of 15 miles between the copper and tin belts, there has been calculated an absolute minimum of over 100,000 h.p. The main falls are the Nzilio and Busanga, shown in accompanying illustrations.

(2) Smelting in high furnaces after the method carried on at Mansfeld and practically the same as ordinary iron smelting. The analyses of Katanga ores indicate that they are adapted to this certain and well understood method of treatment and favorable results are confidently looked for from the investigations with production of metallic copper and slags composed of lime, alumina and silica.

Transportation and Fuel Supply

The great questions now are those of transport and fuel supply. Katanga has been one of the hardest places on earth to reach. It is so deeply located in Africa that with Kambove as a center, a circumference described with a radius of 1000 miles passes close to all points of entry; Congo Mouth and Stanley Falls to the north, Chinde and Beira to the east, Bulawayo to the south and Benguella on the west. Distance is not the only trouble Belts of tsetse-fly country east and south prevent animal transport. Toward the north sleeping sickness cuts off communication and it is more than 1000 miles by the old slave caravan route along the watershed to the Atlantic coast, but a heroic effort is being made to open this for ox-teams. Native carriers only are of service and their number is by no means unlimited.

Railway communication is absolutely essential for further serious work and already three lines are headed for Katanga The Rhodesian (Cape to Cairo) road from the south, the rail-head of which is now and has been for over two years at Broken Hill, a trifle over 100 miles due south of a point on the Congo frontier about 125 miles southeast of the Star of the Congo mine. This road is compelled to build to Katanga, for there is its only chance to get any business whatever so far as known from the north. Tanganyika Concessions is pushing forward its own Benguella railway coming along the watershed from the port of Lobito on the Atlantic coast of Portuguese West Africa.

The third line is the Congo State road from Leopoldville and for which the State has authorized an issue of its own bonds. It is as certain as anything in Africa that these three lines will in time reach Katanga and be there connected by the Katanga railway, the mineral belt line, 60 per cent. of which is owned by the Congo State and 40 per cent. by Tanganyika Concessions. Soon after either of these roads reaches the belt the copper production of Katanga will have to be reckoned with in all markets.

The nearest known source of coke supply is at Wankies on the line of the Rhodesian road between 500 and 600 miles south of the Congo border, but coal is now reported as existing about 300 miles further north and this is being examined. Further, near the Lualaba river and within the limits of the tin area, thin outcroppings of poor coal have been found, and a bore hole has been put down to a depth of 300 ft., the base of the coal-bearing formation being found at 181 ft. Coal occurred at four places in this bore: At 56 ft. in an 8-in. seam; between 68 and 72 ft. in seams aggregating 1½ ft.; between 89 and 100 ft. in seams making 9 in., and at 131½ ft. in a seam of 2 in. The coal in each case was poor, dull and shaly. It is reported, however, that there are indications of this being the edge of a coal region further west, but of this nothing is known for no one has ever been there to see. It is in the air, though, that coal will be found west of the Lualaba. Meantime, all estimates have been based on European coke which can be supplied at a price.

These great deposits of oxidized copper ores are found for 200 miles along a sandstone country, sometimes dipping with the sedimentary layers, at others cutting them almost at a right angle; here folded as an anticline, there as a syncline, but always as beautifully stratified and laminated as if they were themselves sedimentary deposits. Nature has played a most unusual but very regular and orderly prank in the Katanga copper fields.

The Tin Field

North of the copper zone a tongue of granite intrudes, forming the Bia range of hills and beyond this is found the tin belt, extending for more than 100 miles in a northeast and southwest direction from the Lualaba to the Lufira river and nearly at right angles to the copper zone. It was found and traced by hard, close prospecting, but being at some distance from supply stations and local obstacles being in the way not much work has yet been done upon it. At a number of places, however, cassiterite has been found in alluvial wash consisting of angular fragments of pinkish quartz mixed with tourmaline, tourmaline schist and schorl rock. Boulders of cassiterite are frequent, the largest so far weighing 156 lb. and from that down to shot grains. This wash is found along the lines of strong quartz reefs in which bunches and grains of the tin ore have so far been found irregularly distributed, so these reefs are no doubt the source of the alluvial.

Enough is known to make it quite certain that a new tin field has been discovered which will be of commercial importance when transportation arrives. To date work has almost been confined to the Busanga area in the angle of the junction of the Lualsaba and Lufira rivers, where 215 acres have been tested by more than 200 shafts, pits and holes, and found to have a gravel bed averaging 2 ft. 9 in. thick, containing 0.682 per cent. of cassiterite, or practically 6000 tons of metallic tin. The cassiterite contains from 63½ to 65 per cent. tin and it is unmixed with other metals.

The Kasonsa area, further to the north, is known to be much more extensive and important than Busanga. At the latter place rude furnaces were erected and 8½ tons of tin bars run out which were sent to London and sold in the open market, bringing the best price current.

Origin of the Copper Ores

When one leaves the domain of fact and ventures upon theorizing as to the origin of the copper ores of Katanga, it is evident, from the nature of their occurrence, that he at once enters debatable ground. Each of the engineers who has visited the field has advanced his own opinions, but when the remoteness of the district, its thousands of miles of extent which must be traversed on foot, the difficulties of transport and adequate food supply, the advisability of keeping under the influence of fever prophylactics and the irritability of Africa are considered, these opinions must all be taken only as more or less plausible guesses. There is a consensus of opinion that the ores were deposited from copper-bearing solutions but no agreement as to where these solutions came from. Anticlines, synclines and rolls are recognized, but it is not agreed whether these were due to a crustal arching forming the great divide or from local foldings of sedimentary beds. Neither is it agreed whether the ores are in veins or in beds. Quite likely they are in both.

The official engineers have refrained from expressing opinions as to ore in depth for they held that the amount standing above the level of the country was ample for practical needs and purposes. While it may be an anomaly, it is nevertheless true that in the Katanga copper fields the conservative opinion is the one which confines the ore to a fissure, for that puts some limit upon quantity; while to speak of it as a rolling sedimentary bed necessitates, when the full length and width of the zone are taken and allowing for vast erosion, the consideration of hundreds of square miles underlain by copper ores probably hundreds of feet in thickness.

Geology of the District

In a broad way South Central Africa is a granite area of almost continental dimensions, the limits of which to the north and east are undetermined; to the south it extends far toward the Zambesi river,

while to the west present knowledge indicates its continuance across more than a thousand miles to the Atlantic shore line.

Lying in a great basin, which is cut in two by the Bia granite hills, in this vast granite area are the sedimentary rocks of Katanga, and these are of different ages and have been subjected to different forces. The absence of fossils makes it difficult to assign them to definite periods but they have been investigated by M. Jules Cornet, the Belgian geologist, who accompanied the Bia-Franqui exploring expedition in 1892-3, and his work has been carried forward during recent years by F. E. Studt for Tanganyika Concessions. Both of these investigators find three distinct systems of plications or foldings in the Katanga, and Mr. Studt correlates these with the mineral belts. Reasoning from analogy he assigns the plications and metallic formations as probably to the following epochs:

The iron beds to the end of the Ordovician epoch; the tin beds to the end of the Silurian epoch; the copper beds to upper Devonian and lower Carboniferous.

As to the origin of the copper deposits, he says: "The close connection between the copper deposits with the Kafira and Luembe granite in the east and southeast seems to indicate that the local disturbances and the cupriferous deposits themselves, owe their origin to an extensive subterraneous igneous intrusion extending along the whole length of the copper belt. The close relation of these copper deposits with the cellular quartz rocks seems to show that the limestones from which they resulted formed the planes of least resistance along which the country fractured and fissured as a result of the movements connected with the subterraneous intrusion, thus giving vent to the mineralizing vapors which caused the local metamorphism and were the source of the mineral deposits."

Again he states: "The southeastern granites near Luembe river, as have been shown, have a close connection with the copper deposits and these again exist along fracture lines which are closely related to the axis of plication; so that the granitic intrusion which formed the copper and possibly also the gold deposits, was also accountable for the plication of these beds, and occurred about the middle of the Carboniferous epoch and consequently belongs to the Hercynian period when the continent was raised after its long period of oceanic immersion."

This indicates the trend of opinion as to the genesis of the copper ores.

Climate and Surroundings

The local natural conditions for continuous work in Katanga are superb. It is a gently rolling and undulating country, with an elevation of from 4000 to 5000 ft., and is remarkably healthful for Africa. The climate is comparable to that of Arizona and New Mexico. The annual rainfall averages 50 in. and is confined to the summer months, October to April.

Large rivers with many branches flow through fertile valleys and the whole country, except the copper hills and glades along the streams, is wooded, the trees being acacia, mimosa and other African varieties good for some purposes, but not for lumber.

As the goldfields of the Rand have opened south Africa, so will the mineral belts of Katanga develop the center; and a prosperous and populous city, probably at a smelting site near the Nzilio, falls of the Lualaba, will introduce civilization into the heart of the continent.

The Mineral Production of Quebec

We are indebted to J. Obalski, chief of the Department of Mines of Quebec, for the following statement of the mineral production of that Province in 1907. The figures are practically complete, being subject only to slight corrections. They do not include values of metal contained in ore, values of pig iron and ferro-chrome manufactured in the province, nor value of natural gas used. The addition of these items would bring the total value up to nearly $7,000,000. Values given are at shipping points, as stated by the respective operators.

The quantities given are in short tons, except where otherwise specified in the table:

MINERAL PRODUCTION OF QUEBEC.

Mineral.	Men Employed.	Quantities.	Value.
Bog iron ore, tons	100	22,681	$80,231
Calcined ocher, tons.	75	2,300	29,430
Raw ocher, tons		2,700	5,400
Chromic ore, tons	76	6,407	63,130
Copper ore, tons	250	29,574	160,455
Asbestos, tons	2,081	61,833	2,441,919
Asbestic, tons		29,193	27,293
Mica, trimmed, lb		550,247	199,848
Mica, untrimmed, tons	275	91	13,660
Phosphate, tons		408	3,410
Graphite, tons	75	120	5,000
Magnesite, tons		35	5,000
Slate, squares	50	4,336	20,056
Flag-stones, yd	6	3,000	2,550
Cement, bbl.	350		640,000
Granite, cu.yd.	653	51,873	560,236
Lime, bu	124	556,000	96,000
Bricks, M	1462	94,000,000	525,000
Tiles and pottery			270,000
Limestone, cu.yd	515	97,710	223,580
Total	6,092		$5,367,198

The total amount paid in wages during the year was $2,130,010, an average of $349.64 per man.

Asbestos—The production shipped during the year 1907 from the different districts of the Province, is as follows, in short tons:

	Tons.	Value.
1st class, crude	1,485	$367,188
2d class, crude	2,888	456,073
Fiber	19,805	772,513
Paper stock	37,655	846,145
Total	61,833	$2,441,919
Asbestic	29,193	27,293
Total Value		$2,469,212

In all 2081 workmen were employed and $915,061 wages were paid to them; they worked the whole year in the principal mines.

Mica—The production of mica shipped may be summed up as follows, for 1907:

	Pounds.	Value.
1 x 2 thumb-trimmed	204,276	$30,633
1 x 3 thumb-trimmed	139,240	34,891
2 x 3 thumb-trimmed	86,003	44,460
2 x 4 thumb-trimmed	71,852	49,235
3 x 5 thumb-trimmed	24,248	20,090
4 x 6 thumb-trimmed	12,597	13,083
5 x 8 thumb-trimmed	4,074	5,347
Total thumb-trimmed	542,290	$197,739
Split	7,957	2,109
Total	550,247	$199,848

In addition there was shipped 91½ tons of crude mica having undergone a first classification, valued at $13,660; making a total value of $213,508. The mica industry in the Province employed 275 workmen, of which 150 worked on the mines and the others in the classification. The work was done during periods of four to 12 months, and a sum of $100,600 was paid in salaries.

Chrome Ore—The production of chrome ore for 1907 was as follows, in long tons:

	Tons.	Value.
1st class, lumps	145	$1,925
2d class, lumps	3536	33,485
Concentrated	2040	27,720
Total	5721	$63,130

The total corresponds to 6407 tons of 2000 lb. In all 76 workmen were employed during periods of four to 11 months, $31,801 being the total amount of wages paid.

Honduras Export Tax on Gold and Silver

W. E. Alger, Consul at Tegucigalpa, Honduras, transmits the following translation of the decree imposing export duties on precious metals:

Article 1. A tax of 12 per cent. of its value is established on crude silver exported from the country. Article 2. A tax of 2 per cent. of its value is established on gold in bars or dust exported from the country. Article 3. The fixed value of silver for purpose of the tax is 40 sols (the present value of a sol in United States currency is 49.9 cents) per kilo; of gold, 675 sols per kilo. Article 4. The disposition of this decree does not apply to mining enterprises that have concessions granting them free exportation of their metals. This decree goes into effect on date of its publication, Dec. 10, 1907.

The Draeger rescue breathing apparatus with the mouthpiece weighs 36.5 lb.; the form with the helmet 38.9 lb., of which 33.4 lb. are carried on the back. The oxygen cylinders with their fittings weigh 13.9 lb. The price of this apparatus in England is £18.

Cananea Consolidated Copper Company

By Louis D. Ricketts*

The large orebodies of the Cananea Consolidated Copper Company occur at a very considerable distance from the surface, rendering (in all cases but one) open cast work impossible, and the old method of square-setting and filling was found exceedingly expensive on account of the softness and heaviness of the ground. J. H. Kirk has for many years made a serious study of the question of cheaper mining and he finally had a careful investigation made of the caving system in use in the Lake Superior iron ranges. On account of the fact that first-class and second-class ore commonly occur in the same face in our mines, and the necessity for the separation of these two classes of ore, he finally put in practice the "slicing" system and introduced this system in the latter part of 1906. Necessarily there were extraordinary expenses in introducing this system in ground that had been partially worked by square-setting, but at once it showed a decided saving over the old method, and as the men have learned the work and the system has come more and more into general use the reduction in the cost of mining has become very marked. In January, 1907, the cost of mining, including construction was 87 per cent. of the cost for August, 1906. In September, 1907, the mining costs, including construction, were only 63 per cent. of the costs of August, 1906, showing a reduction in these 15 months of about 37 per cent.

During the period in question the condition of the mines made it expedient for us to attack very lean ore. We have, however, large reserves of ore of a much better grade, and when we resume production we shall, as long as the price of copper is below the average of the last 17 months, utilize ore of a better grade.

Developments in 1907

The most important developments on the property during 1907 were in the Oversight and Capote mines and at Puertocitos. In the Oversight we have developed ore to the northwest of previously known ore. We have also struck into this same ore on the third level, but development on this level has not yet proceeded far. Raises from the second level show this ore reaches nearly to the first level. We have done no stoping in the block in question, but from indications there is a very considerable amount of ore in this ground that will yield from 50 to 60 lb. of copper to the ton.

On the southeast end of the Oversight orebody some very good ore has been developed on the second level, and just before the close-down we struck ore of excellent grade on the third level in Blocks 17 and 15, but how extensive this ore is we do not know. It is evident, however, that a run of good ore extends in this ground from the second to the third level.

A very large quantity, several hundred thousand tons, of lean ore has been opened up in the Black Stope of the Capote. It is doubtful, however, if this ore will mine to a grade much exceeding 3 per cent. Capote shaft No. 2 has been sunk to the 10th level, a crosscut run to the ledge and some drifting has been done. Just before the close-down we tapped the water and struck into what may be the extreme northwest corner of the old orebody. At this point there was a small streak of glance in quartzite, and a few feet of crushed quartzite containing copper glance. The ore is not in commercial quantity in this particular crosscut but the fact of finding copper glance at this level is encouraging, and when operations are resumed development in this region will be actively prosecuted toward the southeast where the course of the orebody above would indicate its proper location. In the straightaway from the shaft we passed through about 24 ft. of ore that gave an average assay of 4 per cent. It appears to belong to the north orebody (Black Stope).

A fire started in the old orebody of the Capote mine in July, 1906, and this orebody had to be bratticed off and has been standing ever since. We took advantage of the close-down and pulled our pumps, allowing the water to rise, and also turned into the mine the water being pumped by the Sierra de Cobre Company, adjoining our property. The water is now within 30 ft. of the 4th level and we expect to be able to fill it up to the 4th level. When the water first reached the fire zone tremendous amounts of foul gas escaped from the mine, but since the water got above the 5th level the foul gases have almost entirely disappeared and we believe that the fire is extinguished. In this orebody (not worked for a number of years) it is known that there are large quantities of desirable ore left standing and as filling in the old stopes.

At Puertocitos all underground development was stopped on account of the fact that it was considered more advantageous to spend the money elsewhere where the chances of getting a higher grade ore were more evident, but quarry work was started on the outcrop and was carried on through the year. We have opened up a quarry of an average hight of about 40 ft. and about 500 ft. in length, and there is every appearance of the mountain furnishing a large quantity of ore containing about 3½ per cent. copper and as many ounces in silver at a low mining cost.

At the Elisa mine a considerable amount of development has been done on the 100- and 200-ft. levels of the two winzes sunk from the adit tunnel, with very satisfactory results. This mine was operated during 1907 at a profit, giving a satisfactory class of ore on account of its coarseness, and on account of the facts that it is self-fluxing, makes a high-grade matte, and contains a high percentage of lime.

During 1907 a geological survey of the mines was made under the direction of S. F. Emmons, of the U. S. Geological Survey, assisted by J. M. Boutwell and several other engineers. The maps and field work are completed and the report is shortly expected. We have already had much important advice and information regarding promising ground for prospecting, and excellent results are expected from this survey.

Reduction Works

Chas. F. Shelby took charge of the smelter in July, 1906. He found the reduction works had grown by piecemeal, as is usually the case with first works on new mines. As a consequence they were congested as to location and facilities for handling material, and they lacked proportion throughout. This necessarily caused excessive labor costs, power costs, and fuel costs, and there were large losses in flue dust and great leakage of furnace gases, making the atmosphere in the works almost unbearable. He also found the eight furnaces, of which there were seven different types, completely worn out, as also were the five stands of converters. A careful study of conditions has been made since that time and extensive improvements have been completed or are under way. The problem has been exceedingly difficult because the construction had to be carried on in a congested area, in very bad air, and during continuous operation of the plant, and it was made more difficult by the need of attacking the various improvements as necessity required rather than in logical sequence. The work has all been undertaken on the basis that the saving in labor, power, fuel, and repairs, will pay for it in a year.

The eight old furnaces have been pulled out and scrapped, one at a time. Eight new furnaces have been purchased and seven are completely installed; the eighth is on the ground and will be completed in a few weeks. These furnaces are 4 ft.x17 ft. 6 in. at the tuyeres, the largest size that could be put into the building. They have 20 per cent. more hearth area

*This article is an abstract from the recently published report of the Greene Consolidated Copper Company, which owns the Cananea Consolidated, of which Doctor Ricketts is president and general manager.

than the old furnaces and are capable of smelting 90 per cent. more charge.

Two new stands of converters with eight shells have been installed. They are of the barrel type, of most modern design, and were built on plans carefully revised by Mr. Shelby. They have solid steel heads and riding rings cast in one piece. They are 8 ft. x 11 ft. 6 in. with extra high noses to prevent splashing over. They are electrically operated and can be turned through the complete circle. The three additional stands, with 12 more shells, will shortly be installed. The converter building has been reinforced, braced, and strengthened throughout, the crane runways repaired, and the cranes thoroughly overhauled and rebuilt. Tamping machines of an improved design have been put in for lining the converter shells.

The seven small settlers have been scrapped and replaced by four very large clay settlers of approved design, each serving two of the new furnaces. The slag-track system has been torn out and rebuilt, and the old slag cars replaced by cars of better design and double the capacity. This change has demonstrated that with half the crew employed when we were smelting 50,000 tons of gross charge, we can easily do the work when smelting twice as much.

The blowing capacity for the furnaces has been increased by the installation of a blower of a capacity of 30,000 cu.ft. per minute, driven by a direct-connected tandem-compound engine. The two 42-in. blast pipes that led from the power house to the blast furnaces were crooked, in the way of other improvements, and showed a loss of 160 h.p. in friction. These two blast pipes have been torn out and replaced by a straighter pipe 6 ft. in diameter, with connections, new and complete from the top of the blower to the furnace bustle pipes.

Possibly the most important work, though by no means the most expensive, is the erection of 75-ton steel bins in front of each of the furnaces, in order that we may utilize the mixing-bed system. This work is well under way. The ore from the mixing beds will be delivered into these bins by the existing belt system, and the charges will be measured out and fed into the furnaces automatically.

The reverberatory furnace, 19x100 ft., was in operation during the period in question, but so far the results have not been satisfactory. The tonnage treated was small and the fuel consumption high. Still the flue dust smelted has been done at a figure lower than the cost either of treating such material in the blast furnace or shipping it. Aside from defects in location, flues and cross section, the cost is due to coal that is not adapted to the work. The two coals obtainable are Gallup lignite and Colorado-New Mexico coking coal. Neither will work alone; a mixture of the two gave the best result. Shortly before the close-down we installed Aero pulverizers. These machines showed during the tests no radical faults and there is no doubt that they can be made mechanically successful.

The Railway Department

A railway of 36-in. gage line has been built from a point near the smelter to the America and Cananea Duluth mines, a distance of 4.14 km. From this line a branch has been built to the concentrators 1.75 km. in length. This branch was essential as it not only greatly shortened the haul, but cut out a long 4½ per cent. uncompensated grade. Spurs were also built to the America ore bins and to the Cananea Duluth coal bins. The lowest possible grade line was essential, and as the country traversed was exceedingly rough, the grading was heavy and there were a number of high and expensive bridges. The main line is laid with 50-lb. steel and is ballasted with slag. The maximum grades are 2 per cent. compensated. The cost of this work, completed, was $121,084.

Cost of Mining and Treatment

The cost of mining and beneficiating a ton of ore at Cananea, including the costs of freight, refining, and selling the copper, has fallen year by year. The average cost for the period in question was about one-fifth less than for 1906, and 30 per cent. less than for 1905. This reduction has come almost altogether from reductions in the cost of mining. There will undoubtedly be a further decrease in this item and I look ultimately for mining costs fully 25 per cent. less than the present.

Reduction in smelting charges per ton of ore has not decreased for the reason that at the close-down we were only approaching a point where some of the improvements could be utilized. On the other hand, throughout the period we were charging off the very heavy expenditures for labor and material against operation. When we start up the works, however, the improvements enumerated under the heading of "The Reduction Works" will be completed and we will receive the benefit of all these improvements, and at the same time the large expenditures for extraordinary repairs will stop. We can, therefore, fairly look for a notable decrease in mining and beneficiating per ton when we start up without further notable increase in capital expenditure.

On the same lines we are giving most careful study to other items of cost that may be reduced without large capital expenditure, including the problem of decreasing the percentage of barren fluxes, raising the grade of the matte, getting converter lining containing values instead of using barren quartzite, etc., etc.

Sulphur in Wyoming

Deposits described by E. G. Woodruff, of the U. S. Geological Survey, are situated about three miles west of Cody, along the base of Cedar mountain, on the south side of Shoshone river. Though geologic conditions are favorable for the formation of sulphur both north and south of the river, the deposits considered workable at the present time are confined to a belt two miles long and less than one-fourth mile wide, extending southeastward from the Hot Springs along the foot of the mountains to Sulphur creek. All of the mines now producing sulphur are included in a small area a few acres in extent, near the north end of the mineralized zone south of Shoshone river.

The sulphur occurs in small yellow crystals and in gray streaks in the rocks, and is found in irregular beds in limestone and travertine associated with fine white crystalline aggregates, filling cavities 2 to 8 in. in diameter, and also disseminated through the limestone, where it has been deposited by sulphur-bearing gases permeating small crevices in the rock. The cavities mentioned seem to be portions of subterranean channels through which the hot sulphur-bearing waters flowed and on the walls of which the sulphur was gradually deposited until the chamber was partly or entirely filled. No regular arrangement of cavities has been discovered, though they seem to be in groups at places where the waters found free passage. In the areas between the groups of cavities only a small amount of sulphur is found but in the enriched pockets the sulphur reaches 30 to 50 per cent. of the rock and becomes commercially important.

The sulphur is mined by means of open pits located in promising places. The rock is sorted by hand and all ore estimated to contain more than 30 per cent. of sulphur (the yearly average of the ore smelted is 35 per cent) is taken by wagon or tram to the smelter, near the mouth of the cañon. The sulphur refining and milling plant was built in 1906, and during the first year of its operation produced 850 tons of sulphur from 2833 tons of ore. Of this amount 350 tons were sent to Omaha, Neb., the chief distributing point, and the remainder was used in compounding sheep-dipping preparations in Wyoming and adjacent States. The market price is $35 a ton at Cody. The process used at the plant is not very efficient, as only about two-thirds of the sulphur which the rock contains is melted out; the remainder, being contained in the gangue, is thrown on the refuse dump.

Before repatriation began, the Chinese produced from one-third to two-fifths of the gold output of the Rand.

Promontorio Silver Mine, Durango, Mexico

Shipments of Rich Ore Have Yielded Fully Five Million Dollars; Now the Lower Grades Are Treated at the Mine

BY FRANCIS CHURCH LINCOLN*

The Promontorio mine is situated at the northern end of the Sierra San Francisco de Coneto, in the town of Promontorio, Partido of El Oro, State of Durango, Mexico. As shown in the accompanying sketch-map, the nearest railroad station is Chinacates on the Mexican International Railroad, 82 miles north of the city of Durango. The mine is 16 miles north of the station by air-line. It is reached by means of a good wagon-road which first crosses the Guatimapé plain, passing the ranches of San Antonio and San Julian, to Estacion, a distance of about 15.5 miles; and then entering the mountains, crosses the Sierra to Promontorio, a further distance of 11.5 miles, making in all a distance of 27 miles by road from railroad to mine.

Promontorio is just beyond the summit of the range, at an elevation of about 8000 ft. above sea-level, or 1350 ft. above the Chinacates station. The Castillo de San Francisco, the highest peak in the Sierra, has an altitude of 10,000 ft. and the Promontorio road crosses the summit of the ridge at an elevation of 9000 ft. by a pass just below this peak known as the Puerto del Almagre. The Promontorio mill is situated at Santa Inés, two miles by tram or three miles by wagon-road to the north of Promontorio and about 600 ft. lower.

The Sierra San Francisco de Coneto decreases in hight toward the north and west till it comes to an end at the Melchor Arroyo on the ranches of Melchor and Ramos. Beyond this arroyo another range, the Sierra de la Candela, begins. In the vicinity of the Promontorio mine the hills are very rugged and the surface is furrowed by ravines which contain running streams during the rainy season (July, August and September), but are dry throughout the rest of the year.

Minerals of the District

The country rock of Promontorio is a rhyolite-porphyry. The groundmass is glassy, showing flow-lines, and the phenocrysts are large quartzes and orthoclases, together with smaller and somewhat altered hornblendes. Small grains of magnetite are rather plentiful, and a much smaller number of little crystals of pyrite are to be seen. The rock is, therefore, a typical rhyolite-porphyry, and undoubtedly belongs to the Tertiary rhyolites so common throughout the Sierra Madre of Mexico.

The Promontorio country rock has a well developed joint structure. It is split into sheets which range from less than an inch to more than a foot in thickness and are of considerable length and breadth. The strike of these sheets is about north 20 deg. west (magnetic),

THE PROMONTORIO MINE LOOKING EAST—REFUGIO SHAFT, SAN JOAQUIN DUMP, ADMINISTRATION BUILDING, POWER HOUSE

Note—Abstract of a paper in *Bulletin*, A. I. M. E., Jan., 1908.

*Professor of geology, Montana School of Mines, Butte, Mont.

and their dip nearly vertical but inclining slightly toward the northeast. The only other rock in the vicinity of Promontorio is a rhyolite which caps the range.

The Promontorio vein strikes through the rhyolite-porphyry north 55 deg. west (magnetic). Its dip is vertical at the surface, inclining toward the southwest in depth. Thus it cuts the joint planes of the porphyry at an acute angle in both strike and dip. The Promontorio vein proper has been followed beneath ground for a horizontal distance of 2660 ft., but it cannot be traced so far upon the surface because of the covering of soil. Below ground the vein still continues toward the southeast, while to the northwest it forks, and the west vein, proceeding from the hanging wall of the Promontorio vein proper, has been followed an additional distance of 968 ft. The west vein can be traced on the surface much farther, and is probably identical with the La Luz vein tunneled in a prospect far to the northwest of Promontorio. To the southeast no vein has been discovered which can be identified with the Promontorio vein. Either the vein has pinched out rapidly in that direction, or, as seems much more likely, the vein is older than the rhyolite which makes its appearance to the southeast and has been covered by it.

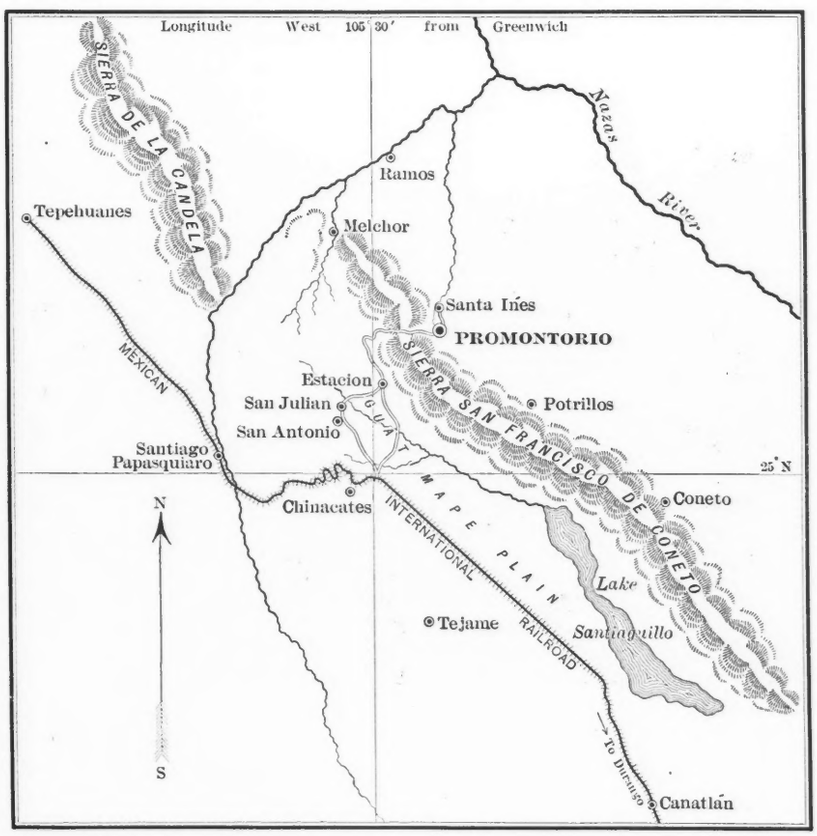
There are no parallel veins near the Promontorio, but there are numerous cross courses, all of which fault the northwest part of the Promontorio vein toward the southwest, the horizontal displacements varying from 1 to 13 ft. These cross courses are in some instances simple faults, while in others they have become mineralized and constitute veins. The most noteworthy example is the Veta Dolores, which strikes north 42 deg. east (magnetic) and can be traced as a well defined quartz vein all the way from Santa Inés to its junction with the Promontorio vein (2 miles) and for some distance beyond. Another important cross course is known as the Veta Atravesada. It is much less marked than the Veta Dolores, strikes north 28 deg. east (magnetic) and is possibly identical with the Los Naufragos vein which has been explored in a prospect to the southwest of Promontorio. All the cross courses dip steeply to the southeast, which makes their junctions with the Promontorio vein pitch steeply in this direction also.

Nature of the Ore

The Promontorio vein is frequently divisible into three distinct parts: (1) a hanging wall portion of vein matter; (2) an intermediate portion of more or less altered country rock, and (3) a footwall portion of vein matter. The principal value of the ore is in silver, and sometimes one, sometimes another, portion of the vein is richest. In general, however, either the foot or the hanging wall portion contains the most silver, and the intermediate portion is most likely to be ore when both foot and hanging wall portions are rich.

Thus the Promontorio ore consists of vein matter and mineralized country rock. The characteristics of the fresh country rock have already been described. It has been mineralized in two ways: (1) by silification and impregnation with small scattered grains of the same sulphides as are found in the vein matter; and (2) by the precipitation of secondary minerals in joint cracks and decomposed spots.

The common primary vein minerals are quartz, galena, and sphalerite, less pyrite, a very little chalcopyrite, and minute quantities of bornite, chalcocite, and covellite. The rare primary vein minerals



MAP OF PART OF DURANGO, MEXICO

are tetrahedrite, chalcocite, argentite, and native gold. The oxidized vein filling consists of quartz, kaolin, hematite, wad, and limonite, with occasional films of malachite and linarite and remains of the sulphides. The minerals which have contributed to the secondary enrichment are native silver, chalcocite, and a little chalcopyrite. The native silver does not contain even a trace of gold. Secondary enrichments occur both in oxidized portions of the vein and in the country rock of the walls and horses.

Considering the frequency with which free silver is still encountered in the Promontorio mine, the rather even grade of the ore is somewhat surprising. In a systematic sampling of the mine, the highest result obtained was 263.6 oz. silver per ton, and only 12 out of 1059 assays exceeded 150 oz. per ton. The ratio by weight of gold to silver in the shipping ore varies from 2:1000 to 3:1000 parts. The presence of small amounts of copper minerals always indicates a high silver content, but in all cases where neither copper minerals nor native silver can be identified in the vein filling, assays are necessary to distinguish between ore and waste.

When the assays are plotted upon the mine map, it is seen that the ore is arranged in shoots which, like the junctions between the Promontorio vein and cross courses, all pitch steeply toward the southeast. These shoots sometimes parallel the faults, while in other cases they are cut by the faults or occur in unfaulted parts of the vein. They are usually long and narrow, extending from 15 to 100 ft. along a level and cutting many levels on their pitch. After continuing downward for a number of levels, shoots sometimes pinch out. New shoots may come in along the line of the old ones, or make their appearance in intermediate positions.

The shoots are either primary or secondary, both pitching in the same general direction. The primary shoots are distinguishable by their comparatively high content of sulphides, by their lack of secondary minerals, and by their habit of being cut off by faults unless occur-

ring in unfaulted parts of the vein. On the other hand, the secondary shoots are recognizable by their low content of sulphides, by the presence in their richer portions of the secondary minerals, native silver, chalcocite, and chalcopyrite, and by their tendency to follow closely well defined faults. The primary ore shoots are dominant in the lower levels, the secondary in the upper. The secondary ore shoots reach their maximum development in the neighborhood of the fourth level, where the Veta Dolores shoot extends horizontally for 460 ft. and the Veta Atravesada shoot for 456 ft.

None of the cross veins have developed ore at a distance from the Promontorio vein, although small amounts of ore have been taken from some of them near their junctions with the Promontorio vein. Considerable prospecting has been carried on, but no other mine has been discovered in the district.

The order of succession of the minerals in the primary ore of Promontorio is: (1) pyrite; (2) sphalerite (period of crushing); (3) quartz; (4) chalcopyrite; (5) galena. Rich primary minerals are excedingly rare at the Promontorio mine. They play no recognized part in the mine's production, although they are probably present in minute amounts in the ordinary primary ore.

Geological History of the Promontorio District

The Promontorio rhyolite-porphyry was extruded during Tertiary time through underlying andesite, dacite and, perhaps, binary granite. Pressure during cooling developed sheet-jointing.

After the consolidation of the porphyry a disturbance took place which resulted in the formation of an extensive northwest-southeast fault, through which heated ore-bearing solutions rose. This disturbance was probably caused by an intrusion of molten igneous rock that faulted the overlying layers and gave forth plutonic emanations, which, ascending through the fault, deposited the primary ore of the Promontorio vein.

The conditions were such that first pyrite, then sphalerite was deposited. A slight rearrangement along the fault led to the shattering of some of the pyrite and sphalerite, and at the same time brought about a change of conditions, so that quartz and, soon after, chalcopyrite were formed. Finally, galena was deposited in all remaining cavities, and the deposition of primary minerals came to an end.

After the mineralization of the Promontorio fault another upheaval took place, which was probably contemporaneous with the extrusion of the rhyolite that caps the Sierra San Francisco. This caused the formation of a series of northeast-southwest faults, several of which intersected the Promontorio vein. These faults were slightly mineralized, perhaps by lateral secretion from the porphyry, but certainly in a different manner from the Promontorio fault.

The district was covered by rhyolite for a while, but, when this was eroded, the only partly filled cross faults formed convenient channels by which surface waters were tapped off, and, entering the Promontorio vein in the neighborhood of these cross faults, rearranged its contents. Rich deposits of secondary minerals were thus formed in the vicinity of the cross courses.

Mining

The Promontorio mine was discovered by Joaquin Contreras in 1880, and purchased by its present owner, the Negociacion Minera de Promontorio, S. A., in 1887. It is at present the only real mine in the whole Sierra San Francisco de Coneto district. It should be noted, however, that the famous Potrillos tin deposits are situated in these mountains, and that a system of silver-gold veins at Coneto has been worked intermittently for a long period of time.

When mining began at Promontorio, it was necessary to freight the ore 260 miles to the railroad at Fresnillo. At that time, shipping ore had to contain at least 240 oz. of silver per ton. In 1892 the railroad reached the city of Durango, making it profitable to ship 90-oz. ore; and when, in 1900, the branch line was opened to Chinacates, 60-oz. silver ore could be shipped at a profit.

THE PROMONTORIO MINE, LOOKING NORTH—POWER HOUSE AND MINERS' CABINS ON LEFT

The mine was first opened by the San Joaquin shaft, on a hill-side, and later by the Cinco Señores workings, farther up the hill. The present main working shaft, the Refugio, is in the ravine beside the hill upon which the older openings are situated.

This shaft has been sunk to a depth of 675 ft., of which the first 280 ft. are in the vein, and 14 levels run from it. Levels 1 to 9 are 40 ft. apart; levels 9 to 14 are 71 ft. apart. Level 1 is a tunnel which starts at the mouth of the shaft and passes into the hill to the southeast, where it connects with the early workings mentioned above. This of all the levels extends farthest toward the southeast. The other levels are all drifts run in both directions on the vein for

longer or shorter distances. Level 9 extends farthest toward the northwest, passing the fork in the Promontorio vein into the west vein and finally connecting with another shaft, the Santa Maria, at a depth of 250 ft. From the southeast face of the first level to the northwest face of the ninth level is a horizontal distance of 3628 ft. A crosscut from a point in the Santa Maria ravine a short distance below the Santa Maria shaft intersects the fourth level.

When I visited the mine in the fall of 1906, the method of operation was as follows: All the material mined was trammed out to a *patio* or sorting yard by means of the crosscut from the fourth level. Rock mined above the fourth level was dropped to it, and rock mined below was raised to it by the hoist at the Refugio shaft. On the *patio* the produce of the mine was sorted to "shipping" ore, running 60 oz. of silver per ton, and better. The rejected material was thrown on the milling dump when it ran better than 20 oz., and on the waste dump when worse. Since I left Promontorio, a mill has been started, and it is probable that ore of the grade formerly shipped is now being milled together with the lower-grade material.

The power house, situated in a small *arroyo*, across from the main shaft contains six tubular boilers, which burn wood and supply steam to the hoist and compressor, and to engines operating generators. The electric current generated supplies power at the *patio*, illuminates electric lamps, and operates the pumps. A 120-kw. alternating-current generator supplies the power to four 3-in. Worthington electric pumps. In the dry season the pumps are worked for eight hours a day, and raise about 96,000 gal. of water to the fourth level daily. Most of this water comes from the fourteenth level, a distance of 555 ft. In the rainy season, it is necessary to run the pumps fourteen hours a day, thus raising 168,000 gal. per day.

Fire-wood delivered at Promontorio costs $2.50 per cord and lumber $17.50 per 1000 ft. The wages paid per day are as follows: Miners, $0.75; laborers, $0.375 to $0.75; machine drillers, $1.25; shift bosses, $1 to $1.25; timbermen and carpenters, $0.875; blacksmiths, $1.25; hoistmen, $1.25; engineers, $1; firemen, $0.625.

Labor is, on the whole, plentiful. Some difficulty is experienced in keeping sufficient men at the mine during the periods of sowing and harvesting of crops, for the Durango laborer prefers farming to mining. Another peculiar condition has to be met in cold weather, when all hands want to work on night-shift because their cabins are too cold to sleep in at night, but are warmed to a more comfortable temperature by the sun during the day. With the exercise of a little tact there should be no difficulty in obtaining all the labor desired.

Milling

Milling operations did not prove a great success at Promontorio in the early days of the mine. One brand-new mill, which had never turned a wheel, was completely destroyed by the collapse of a dam. Another mill was erected later, but failed to give good extractions, as the tailings-dumps bear witness. Gordon Wilson carried on a long series of milling tests upon Promontorio ore, and came to the conclusion that the best results could be obtained by concentration, followed by sliming and cyanidation of the tails. His experiments indicated that 45 per cent. of the value could be extracted by concentration in 10 per cent. of the weight, and that, of the remaining 55 per cent., 89 per cent. of the silver, and practically all the gold, could be extracted by sliming and cyaniding for a period of 10 days. This would mean a total extraction of 94 per cent. Mr. Wilson, therefore, constructed a 50-metric-ton concentrating and cyaniding mill at Santa Inés, which has now been in operation for several months.

The dam which supplies water for this mill is situated midway between Promontorio and Santa Inés. It is 100 ft. high, and was constructed at a cost of $50,000.

Production

The smelter returns on shipments from Promontorio are reported to have been about $5,000,000. Unfortunately, no records of the quantities of gold and silver produced were kept during the early bonanza days of the mine. From Dec. 5, 1896, to Aug. 18, 1906, there were produced and sold 5,689,618 oz. silver and 15,857.4 oz. gold. During this period of recorded production the Promontorio mine lost its position as "one of the largest producers of silver in Mexico,"[1] and became one of the many minor producers. At present there is but little shipping ore in sight in the mine, but there are large reserves of good milling ore, and, with new and effective milling methods in full operation, we may soon expect to see the Promontorio mine make its way to the front once more.

Restoring Dredged Ground

Of late years considerable attention has been given to the study of the problem of restoring dredged ground to usefulness. In Australia and New Zealand far more attention is devoted to this problem than in the United States, although several attempts have been made in California to restore the fertile land of the Sacramento valley to usefulness after it has been dredged.

All these attempts depend upon screening the soil and fine sand from the coarse gravel and depositing these separately on different parts of the area that has been already dredged. As stated the problem appears simple, but to make this separate deposition of the coarse and fine material at a small cost is not so easy.

The deeper the soil cover, the easier is the problem for then there is an ample cover to place over the gravel. Besides the nature of the sand and gravel also affects the fertility of the restored ground. Unfortunately the fertility of soil depends largely on the extremely fine particles, the silt, for its fertility. This is the part most readily carried away by the water and the part most likely to be carried deep down in the gravel.

When the gravel is composed of many pieces of sedimentary rock and coarsely crystallized igneous rock the restoration of the land is more apt to succeed, for the finer particles of sand from such gravel decompose rapidly and in time restore to the soil the silt portion.

At Eurobin in the State of Victoria, Australia, the attempt to restore the ground to usefulness has been, according to the *Australian Mining Standard*, Feb. 12, 1908, very successful in the case of the Confidence dredge. A small area of the surface soil is stripped by the dredge and deposited on top of gravel-covered ground before the gravel, underlying the area that is being stripped, is touched. An ingenious arrangement of a series of iron troughs which by pulleys and ropes are easily swung into or out of position are used to carry the soil to its proper place. As the dredge moves about the chute moves also, and so changes the place of depositing the soil covering. Only as much water as is necessary to transport the loam through the trough is added to the loam. This decreases the amount of silt carried deep into the gravel.

Barite in Georgia

A brief report on a deposit of barite near Cartersville, Ga., has just been published by the United States Geological Survey.

The barite of the Cartersville region is closely associated with certain iron ores, and particularly with ocher. It is called by the miners the "flowers of ocher," and its presence in the residual soil of the region has been a means of tracing the ocher deposits.

At one place nearly three miles southeast of Cartersville barite has been mined for at least six months on a rather large scale, more than a thousand tons, valued at about $4000, having been taken out.

The principal mining camps of San Luis Potosi are Catorce, Charcas, Guadalcazar, Cerro de San Pedro, Bernalejo, and Ramos. Approximately 13,000 miners are employed in the State.

[1] Ingalls, *Trans.*, A. I. M. E., XXV., 149 (1895).

Recent Developments at Cerro de Pasco, Peru

Mines Have Been Opened, Railroads Built, Coke Ovens Constructed and Smelting Works Erected for the Production of Copper

BY J. C. PICKERING*

Literally translated, the name Cerro de Pasco means "hill of riches." The district discovered by the Spaniards prior to 1630, is accredited with having produced during the succeeding 250 years, 15,000 tons of silver bars; during this period the mines were worked solely for silver. As an evidence of the activity of the Spanish miners, there are enormous open cuts or pits known locally as "tajos," 400 to 500 ft. in diameter and up to 200 ft. in depth. The mined products of these pits were treated by the *circo* or *patio* process of amalgamation, the assay value of the *pacos* or oxide ores extracted averaging between 14 and 20 oz. silver.

It was not until 1897 that the copper ores of Cerro de Pasco received serious consideration from the Peruvians. In that year the Peruvian mint which had previously been purchasing the silver produced at the Cerro de Pasco mines, closed its doors, making it necessary for the mine owners to seek foreign markets. The additional expense incurred in shipping and insuring bullion to London buyers made it necessary for most of the patios to shut down. At the same time copper having risen, the more progressive mine owners began looking for a way to profit by the large stores of copper ores which, in the course of mining for silver, had been rejected or left in the mine as filling. Due to the heavy transportation costs, it being necessary to pack the ore on llamas to Oroya and thence to ship it by rail to Lima, ore running under 30 per cent. copper was neither exported to England nor sent to the custom smelters at Yauli and Casapalca. It then became necessary to devise a means of enriching, in order to stand transportation charges, the large reserves of 15- to 25-per cent. ore remaining in the mines.

It should be borne in mind that the cost of packing machinery the 80 miles from Oroya made that a prohibitive item to the small mineowner. The problem was solved by the employment of reverberatory smelting, preceded by roasting, for which the Cerro de Pasco ores are especially adapted, due to their practically self-fluxing properties. The process was very uneconomical, the object being largely to convert 15- to 20-per cent. ore, which up to that time had been unproductive, into 50-per cent. matte, which could be shipped profitably. In 1902 there were 14 of these plants in operation, with a total annual output of about 7000 tons of 50-per cent. matte. The fuel used was largely *taquia*, the refuse from llamas, mixed with peat and bituminous coal of poor grade.

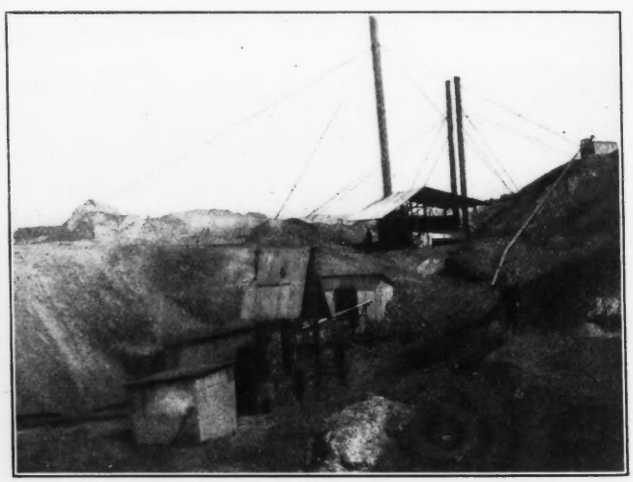
The accompanying table gives statistics of some of the larger plants:

The following are the transportation costs prevalent before the completion of the Cerro de Pasco Railroad, between Cerro de Pasco and England for ores and mattes, per ton of 2000 lb. in dollars, gold:

By llama from Cerro de Pasco to Oroya	$25.00
Railroad, Oroya to Callao	11.00
Handling, sampling and commissions	2.00
Steamer to Europe	7.00
Handling, sampling and commissions	2.00
Total	$47.00

In addition to the heavy cost of shipment to the market, the system of mining employed made the expense of extracting the ore unusually high. In opening a property no attention was paid to development with regard to future extraction, the sole object being to get at the rich ore in the quickest possible time. The result was that when the Cerro de Pasco Mining Company began operations, the mines which it had purchased were found to be in a most deplorable condition. The old "Coyoting" system had been used in working these properties, the first opening usually being a *media barreta*, or slope, with steps cut in the floor for the men ascending with loaded *capachos*. Beyond this main entrance the workings consisted of drifts of the smallest possible size generally altogether unsupported by timber. The ore after mining is carefully hand sorted and closely cobbed and is generally divided into three classes: shipping ore, smelting ore and waste.

DIAMANTE SHAFT



NAZARENO SHAFT

OPERATIONS OF CERRO DE PASCO REVERBERATORY PLANTS, 24 HOURS.

Name of Plant.	Copper in Ore.	Silver Oz.	Kg. of Ore Treated.	Kg. of Matte.	Copper in Matte.	Copper in Slag.	Men Employed.
	Per Cent.				Per Cent.	Per Cent.	
El Triunfo	16–17	tr.	6000	2400	50%	2%	6
El Carmen	13–16	7	5500	3000	55%	1–5%	7
El Misti	18–25	3	2600	1600	50%	1–5%	5
Tutupaca	20–23	6	7000	3200	55%	2–5%	9
San Jacinto	8–9	6	11000	2000	50%	2%	10

*Mining engineer, El Oro, Mexico.

Character of the Deposits

The rock of the district is in general a highly silicious limestone, striking north and south and dipping gently to the east. To the west of the mineralized zone, as at present known, an intrusion of andesite occurs; the limestone at the contact is heavily metamorphosed. The orebodies, as at present defined, are by some authorities attributed to replacement of the limestone by the metals deposited from rising solutions. The ore occurs in three distinct forms: veins, blankets and pockets or shoots. In the upper portion we find the *pacos* or oxides of iron and manganese, together with the common carbonate and oxide copper ores; in the lower levels chalcopyrite, bornite and tetrahedrite predominate. Chalcocite has not, I believe, been met with as yet.

The mineralized zone, as at present determined, covers a territory extending about one mile in a north and south direction, and one-quarter mile east and west, but it is generally conceded that the orebodies extend much farther to the west, than at present indicated. Spread along the eastern edge of the mineralized zone lies Cerro de Pasco, a town of about 14,000 inhabitants. Since the arrival of the railroad, the place has improved considerably, but it naturally retains the characteristics of most South American towns, i. e., narrow, crooked streets, together with conditions which are far from sanitary. To the north of the mineral zone are two gulches, the first located to the northeast and leading to Quinua, seven miles distant, the location of the Chuquitambo gold mines; the second gulch leads to the northwest and in it at a distance of about two miles is the Rumillana drainage tunnel.

The town of Cerro de Pasco together with the mines, may be considered as being situated in a small basin whose greatest diameter is four miles; this basin is surrounded by gently undulating hills, and opens to the north through the two valleys previously mentioned; it is closed for the most part to the south and east, but drains to the southwest into Quilococha lake. At this latter lake is located the mouth of the Quilococha drainage tunnel, driven about 30 years ago, the total length of which is nearly a mile. This tunnel taps the deposit at about the 300-ft. level. The Rumillana tunnel secures about 100 ft. greater depth.

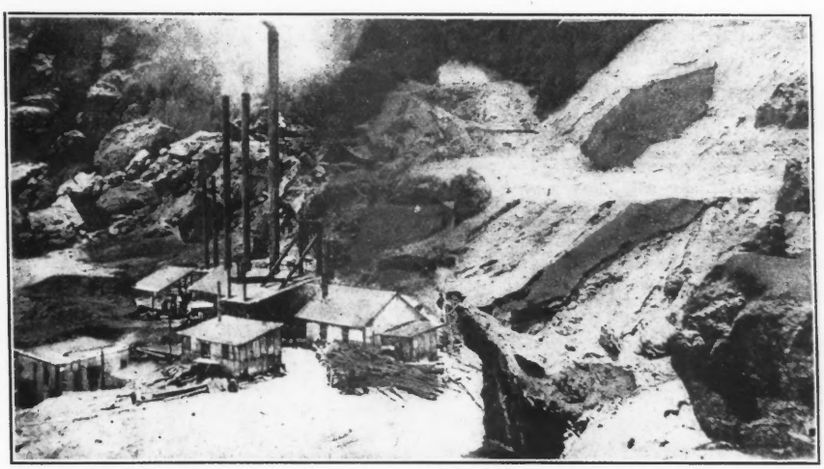
Cerro de Pasco Mining Company

In 1901, the advent of American enterprise in the form of the Cerro de Pasco Mining Company introduced a new era in the life of the Cerro de Pasco mines. In order to facilitate the transportation of heavy hoisting and pumping machinery, mine timber, etc., the company constructed an 80-mile wagon road to Oroya. Work was shortly after begun on buildings, shafts, etc. In the six years intervening between that time and the present, this company has sunk seven shafts to an average depth of 300 ft. (the Noruega, Carmen, Pena Blanca, Lourdes, San Diego, Diamante and Nazareno) driven about eight miles of drifts, raises and winzes, opened up large ore reserves, erected office buildings, shops, etc., and connected the three principal shafts, the Noruega, Lourdes and Diamante, by means of spurs with the railroad. The shafts Diamante, Carmen and Pena Blanca and Noruega are below the 400-ft. level.

OFFICE BUILDINGS AND SHOPS, CERRO DE PASCO MINING COMPANY

The construction of the Cerro de Pasco smeltery, designed by Frank Klepetko and located nine miles south of the mines at Tinahuarco along the main line of the railroad, and also connected with the company's coal mines by a branch line, was begun in the spring of 1904, the construction being under the direction of A. H. Kennedy, and was blown in in January, 1907. The plant, which is on a side hill location, is of steel construction throughout, and is roofed and walled with corrugated iron. As at present operated with three furnaces, the capacity is about 500 tons of ore per 24 hours. The furnaces are 56x180 in.; there are 12 tuyeres on each side operating under an 18- to 20-oz. blast, and the furnaces tap into two 18-ft. settlers, having a capacity of 30 tons each, and each of the intermediate settlers being common to two furnaces. The furnace gases pass through a concrete flue leading to a 185-ft. steel stack. The slag is granulated and sluiced out to the *pampa* at the foot of the hill.

An 80-ton crane, operated by alternating-current motors, is the carrying medium for four-ton matte pots between the settlers and the converters. Of these latter there are four stands, the converters being 6 ft. in diameter and 14 ft. long, with 14 tuyeres operating under an 18-lb. blast. The coke for the plant is made at the works by a double bank of 70 beehive coke ovens, 35 on a side, the capacity of each oven being 6 tons coal or 2½ tons of 48-hour coke. The coal before being coked is cleaned at a 500-ton coal washer in order to reduce the ash; this washer is also located at the smelting works. There are now in course of construction several 19x60 ft. reverberatory furnaces, each of which is to be fed by



CARMEN SHAFT

calcines from Klepetko-Evans-MacDougal mechanical roasters. The reverberatories are being built for the purpose of treating the fines, the coarse ore after screening, going directly to the blast furnaces. In as far as possible all charging, handling, etc., is done mechanically.

The power house contains three Connersville blowers of special size, a large cross-compound compressor for the converters, together with a small straight-line compressor for riveting and other purposes, and dynamos for operating crane and auxiliary motors supplying power to the machine shop, the carpenter shop, sampling mill, etc. The machine shop is of sufficient size to allow the erection of the large locomotives used on the Cerro de Pasco railroad and is adequately equipped for all possible repair work. There is also a carpenter shop of good size, and a foundry with cupola for melting, and capable of producing large-sized castings. In addition there is a large store-house, and steam-heated living houses for employees.

The various buildings are connected with the main Cerro de Pasco line by means of a system of spurs and all local switching, charging furnaces, etc., is done by small Davenport locomotives. The ore from the various mines is dumped directly from 30-ton gondola cars which run on a steel trestle into 24 bins, the capacity of each being about 250 tons. This same railroad trestle also supplies the sampling mill bins with the ore from such cars as require sampling. From the 24 bins the ore is fed to 2-ton blast-furnace charging cars, the required amount of limestone being added to these same cars. The smelter site was chosen with the object of enlarging the plant by units similar to the one in operation. In this case the present steam plant will be used as an auxiliary plant only, as plans have been completed for a large power installation to be made on the Montaro river about 30 miles distant, which will, of course, involve electric transmission.

Other Plants

The only other blast furnace in existence near Cerro de Pasco is that of Sr. Eulogio Fernandine, a Cerro de Pasco mineowner; it is located at Huaraucaca about two miles from the Cerro de Pasco smeltery. This plant which has recently been enlarged to a capacity of 90 tons per 24 hours, was built in 1899 with one 30-ton furnace. The plant is at present treating Cerro de Pasco ores running from 10 to 15 per cent. copper and 5 to 7 oz. silver. The ore is first roasted in a Brown reverberatory using *taquia* as fuel, reducing the sulphur from 30 to 35 per cent. down to 12 per cent. The roasted ore is briquetted, and together with some raw ore, rich slags and matte crustings, limestone and 10 to 15 per cent. coke is charged into the blast furnace, giving mattes averaging 50 to 60 per cent. copper and slags running 1 per cent. copper. The coke used is native Oyon or Gollairisquisca, costing $20 to $25 per ton at the plant; it is generally mixed with some imported German coke, costing $40 laid down at the plant. The great disadvantage of the native coke, is that besides being heap-coked in the open air, it has to be broken down very fine in order to permit of packing by llamas. Connected with the smelting works is a small concentrator, consisting of five 850-lb. stamps, one four-compartment Harz jig, one ball mill and two 14-ft. vanners. This mill is at present working on ores from the mine at Colquijirca, six miles south of Cerro de Pasco.

Sr. Fernandine is undoubtedly the most progressive, as well as successful of the individual mineowners of Cerro de Pasco. He has recently completed and has in operation the first unit developing 1400 h.p. of a hydraulic-electric installation for transmitting, under high tension, power to be used in running hoisting and pumping machinery at his mines in Cerro de Pasco and Colquijirca. The power station is located about 15 miles to the southwest of Cerro de Pasco. His mining properties, plants, etc., have been under consideration for purchase by the Cerro de Pasco Mining Company, as well as by several other concerns, but has thus far resulted in nothing, probably due to the high price asked.

The Rumillana Drainage Tunnel Controversy

The idea of driving a long drainage tunnel to unwater the Cerro de Pasco mines below the zone effected by the Quilacocha tunnel was considered seriously previous to 1875, by Henry Meiggs, the builder of the Peruvian Central railroad. It was not until 1900, however, that the project became an assured fact, when a concession was granted to the Empresa Socavonera, giving it the following privileges within the zone, affected or unwatered by the tunnel: (1) Should the mineowner do his own mining, the tunnel company to receive 20 per cent. of all ore extracted; (2) should the owner not choose to mine his ore and the tunnel company do so, the company to receive 60 per cent. of all ore extracted.

The length of the projected tunnel is nearly two miles. In order to expedite work, operations were also started from two old shafts, Mezapata and Yauricocha, the latter being the terminus of the tunnel, and thus giving three working faces, besides the main tunnel heading. The idea was well conceived but failed utterly in practice. Heavy pumping and hoisting machinery was purchased and installed in the Yauricocha shaft, but the company was never able to pass a zone of soft ground, which finally caved in and buried the pump and cage. Since then no attempt has been made to open up the shaft. After this misfortune at the Yauricocha, nothing much has ever been done at the Mezapata shaft and this part of the idea was abandoned. The main tunnel heading was, however, pushed with all speed, using air drills, mule tramming and working three 8-hour shifts.

In 1905 the tunnel was far from entering the mineralized zone which should have been reached in accordance with the agreement. The company, therefore, asked for an extension of time. The Cerro de Pasco company at that time controlling between 75 and 85 per cent. of the mines in the affected zone, vigorously protested. The Government, however, granted the extension with the result that the tunnel is at present completed, and the matter is being fought out in the Peruvian courts.

The defense of the Cerro de Pasco Mining Company against the alleged illegability of granting the extension, is largely based on two facts: (1) That the company as majority holder in the affected mines should have been considered when the extension was asked for; (2) before the Rumillana tunnel reached the affected zone, the Cerro de Pasco company had already reached points below the level of the tunnel with the shafts, Diamante, Pena Blanca and Carmen, and that, therefore, the tunnel in no way benefited the company and hence should derive no benefits from mines in which the Cerro de Pasco company was interested. The Empresa Socavonera is a stock company quoted on the Lima Exchange and is said to have issued 750,000 shares of stock, par value of ten *soles* each. The stock is at present quoted at prices varying between seven and eight *soles*.

The Cerro de Pasco Coal Mines

Besides the properties described, the Cerro de Pasco Mining Company is operating two coal mines. The first at Vinchuscancha, six miles west of Cerro de Pasco along the line of the coal branch of the Cerro de Pasco railroad, has recently been shut down. The coal seam, which varies in width from 2 to 15 ft. has been worked heavily for the past 50 years and in order to secure virgin ground an 800-ft. crosscut was driven to cut the seam, which was then both drifted and sunk upon and worked persistently for about four years. The coal from Gollairisquisca collieries is, however, of superior quality, both as regards ash and coking qualities, and it is for this reason, I am informed, that Vinchuscancha has been shut down.

Previous to the completion of the coal branch connecting the Gollairisquisca collieries with the Cerro de Pasco in

1905, a wagon road was constructed and used for several years to supply the Cerro de Pasco shafts with the necessary coal.

The principal workings of these mines are located near the foot of a *quebrada,* about 800 ft. below the terminus of the railroad, to which they are connected by a surface gravity tram-way. The coal is of fair quality and occurs in seams of variable width in sandstone.

Drilling operations with Keystone churn drills, and Sullivan diamond drills are being carried on to determine the probable continuity of the seams.

A Down-draft Blast Furnace

By R. L. Lloyd*

About a year ago, in conversation with the editor of the Journal, I suggested the possibility of operating a blast furnace with the draft reversed. I have dreamed about this idea for some years and have been always on the lookout for some opportunity to try the experiment and see just what would happen if the blast were taken in over the charge and discharged through the tuyeres or in other words, if the furnace were operated backward. It seemed to me that by this method of procedure some flue-dust questions would be minimized and that an excellent opportunity would be presented for heating the blast with the discharge gases of the furnace.

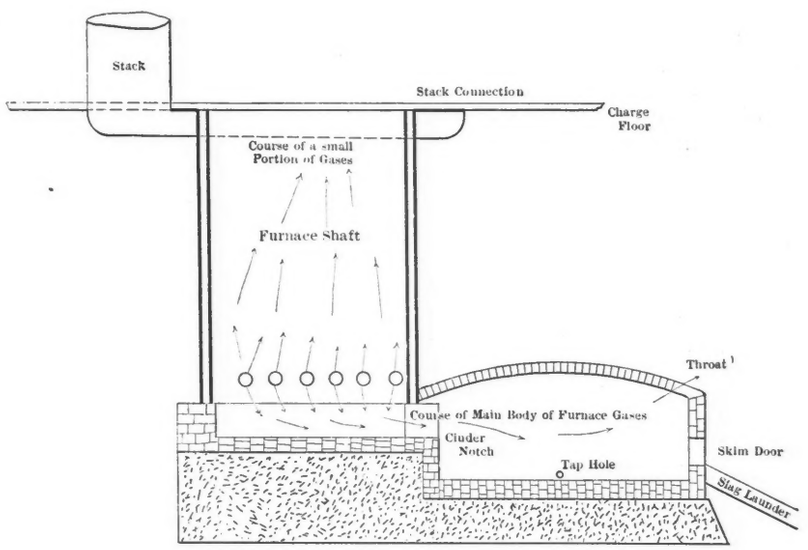
Having had this in mind for so long a time and thinking of it purely as a matter of interest, I was surprised to find in Chile a furnace operated in this manner. The method of blowing this furnace is not quite such a radical departure as suggested at the beginning of this article, but the result is almost identical with that which would probably follow the method of procedure suggested above.

This remarkable furnace is in the Volcan smelter in Chile, just east of Santiago, near the junction of the Volcan and Maipu rivers. It is a small concern owned by Don Gregorio Donoso who is responsible for the procedure which I will describe. The problem to be solved by Señor Donoso was the smelting of a chalcopyrite ore, the gangue being a hematite comparatively low in silica. In the Volcan region there is no silicious flux carrying valuable metals, so naturally Señor Donoso attempted to smelt without flux. The result of this was a slag so very basic that it would freeze in the spout, or if not in the spout surely in the fore-hearth. It would be a long story to tell the various experiments carried on by Señor Donoso and of the difficulties brought about by the situation of the smeltery (40 miles by ox-team from the nearest railroad), but the problem was solved beautifully by a plan which amounted to turning the furnace upside down. A fore-hearth was built in front of the blast furnace in the shape of a small reverberatory and bricked in solidly to the cinder notch. This fore-hearth was roofed over and a throat or gas exit left on the end farthest from the blast furnace. Of course this throat can be regulated in size. The blast furnace opens directly into the fore-hearth, under the roof, the cinder notch being 14 or 16 in. square. In operation the air from the tuyeres passes down through the charge, out of the cinder notch into the reverberatory fore-hearth, through the reverberatory fore-hearth and finally escapes from the throat where the gases burn with a brilliant flame. The interior of the fore-hearth is thus at all times kept at reverberatory furnace temperature and the excessively basic slag is kept liquid and skimmed off from time to time. The matte contains about 55 per cent. copper and the slag carries less than 1 per cent. copper.

On top, the furnace shows no signs of what is happening below; in fact it is hard to believe that it is working at all. The only evidence that anything is going on downstairs is a lazy, thin smoke observable from time to time on the charge floor. There is no dust chamber; in fact the furnace makes no dust. There is a stack at one side of the furnace, but I never saw any smoke come out of it. There is no hood or other upper work of any kind; this leaves the charging floor perfectly clear. The furnace runs with a neutral or reducing atmosphere and uses about 14 per cent. of coke. It is apparent that this could be greatly reduced by using the escaping gases at the fore-hearth to heat the air before it goes to the furnace, which Señor Donoso proposes to do at his earliest opportunity.

No special effort was made by Señor Donoso to increase the depth of the furnace below the tuyeres, so the charge receives practically no preparation before reaching the smelting zone. I believe the operation would be vastly improved by considerably increasing the distance between the tuyeres and the hearth proper.

There are several other interesting things at the Volcan smelter, among them copper converters worked by hand. Indeed it is a real education to visit this place and see what astonishing results can be obtained by means which appear absolutely inadequate. Señor Donoso modestly disclaims any special metallurgical knowledge and insists that he is a lawyer, but to my mind the Volcan furnace is one of the cleverest solutions of a hard problem that I have ever seen.



VOLCAN FURNACE, VERTICAL SECTION

*Consulting metallurgical engineer. 25 Broad street, New York.

Iron-ore Production in 1907

Returns received by the U. S. Geological Survey from producers known to represent about half the output of the country, indicate that the total production for the year will fall between 52,000,000 and 54,000,000 long tons. The total production in 1905 was 42,526,163 long tons; that of 1906 was 47,749,728 long tons. The Lake Superior district seems to show an increase of about 15 per cent.; the Southern district shows an increase of only 4 per cent.; and the Northeastern district gains 8 per cent. The Western district appears to show little or no gain over 1906.

The greatest lead-producing district of Colorado has been Leadville. Other important lead-producing districts have been Monarch, Aspen, Lake City, Ten Mile, Gunnison, Georgetown, Rosita, Creede and Red Cliff.

Lubrication of Air Drills

By Claude T. Rice

The air drill is the most abused machine in use about mines, for it is supposed to be able to stand all kinds of rough usage. No one seems to have any real respect for the air drill, although many discuss the merits of one machine over another. The fact seems to be that four or five standard makes are about equally good, and, if half the time spent in proclaiming the merits of one drill over another, by persons not directly interested in the manufacture or sale of drills, were used in an attempt to find an efficient lubricator for use with air drills, mining would be much more benefitted.

The miner, seeing a machine whose interior parts are as well finished as the interior of a steam cylinder, furnished to him without any provision for oiling, naturally forms a sort of contempt for it and decides that it can stand any treatment; therefore he acts accordingly. He hammers the machine in his rage, when a hole becomes fitchered, although a little shifting of the machine on the arm or a little raising or lowering of the arm on the bar might have saved the hole. Of course such treatment of a machine is foolish, but when I hear some person ascribing high repair bills entirely to the "fool" machineman, I often wonder who is the fool; the miner, who hammers the drill with a "double-jack," or the man with the T-square in the designing room, who is spending all his time on improving the construction of the valve, the piston, the ports and other such refinements, so that he cannot find time to devise an efficient means of lubricating the machinery.

Of course the man with the T-square says that there is no use in designing a means of oiling a machine that works under such conditions; the oil, he says, will only cause dust to stick more readily to the moving parts and cause them to cut. But the air in a raise is no dustier than the air near rolls that are crushing dry ore, and no one advocates the non-lubrication of such rolls.

In present mining practice, at least in the Western camps of the United States, the air drills that are oiled six times a shift are like the dodo bird, hard to find. The machineman, as soon as he has rigged up and connected the hose, pours some oil in the valve, tells the helper to stand back, starts the machine, and blows oil all over the stope. The drill is then generally considered to be properly lubricated until noontime; after lunch the drill gets another "dose of oil," and the stope a second coat.

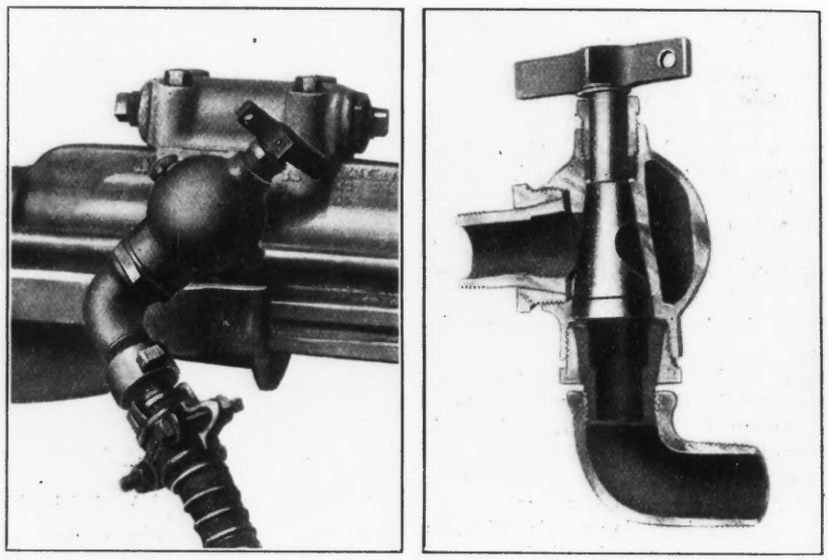
The oil is generally kept in a tomato can; half the oil is spilt in the stope, and the half that is used is soon heavily laden with rock particles. Sometimes a miner, more careful than his mates, will bring from home an empty syrup can. Such a can makes a good oil can, provided it is stoppered after using and provided also it is placed at blasting time in some place where it will be safe from puncture by a flying rock.

Some companies, becoming impressed with the great waste of oil, try to remedy the difficulty by furnishing an iron oil can to the miner. But as the company charges the miner 50c. for the oil can until he returns it, the miner reluctantly receives the can, for he knows sooner or later that he will lose it. Finally the can is lost and the miner spends 50c. worth of his time hunting for the can, and, in case a wrangle arises through his accusing some other miner of stealing or hiding the can, a good deal more time (and possibly some blood) is lost. The result is that by using this can, which is no better than the old syrup can, a lot of valuable time is lost in hunting for the can when it is lost. The company thinks that the miner pays for the lost can, and so he does, but the company also pays considering the time that is lost. The trouble is not in the oil can; it is in the method of lubricating the drill. Any can (but not any bottle) that keeps dust out of the oil is good enough. The remedy is not in buying iron oil cans, but in insisting that the manufacturers devise some efficient lubricator to go with their air drills.

There is great need for an efficient lubricator, continuous or intermittent, attached to the drill or, better still, incorporated in its design. As the speed of movement and number of strokes increases as the use of hammer drills increases, the need of a continuous lubricator or oiler also becomes greater. It seems to me that this is the direction for immediate advance in drilling practice rather than ultra-refinements in interior design of the valves, ports and cylinders. It appears that in view of this need a useful adjunct to the machine-drill will be found in the Western lubricating valve, which I do not hesitate to describe, although I have never seen it in operation. I am informed that this valve has been used by the Granite Gold Mining Company, at Victor, Colo., for more than six months, and D. L. McCarthy, the superintendent, says that it has proved satisfactory in every respect; that the drill is kept lubricated under all conditions; and that, while the drill is running, the valve remains in whatever position that it is turned by the machineman, which is a strong recommendation for the use of this valve on one-man machines.

It is an internal-pressure valve, conical in shape, which fits into a barrel that is surrounded by the oil reservoir. The valve plug and the barrel have ports which register when the valve is closed, so that then air is admitted to the top of the oil reservoir. Another duct leads from the bottom to a groove in the valve plug. This groove in the plug, when the valve is opened, connects with the main air-way of the valve at both its ends, so that the oil is forced out into the air-way, and is then carried by the air into the drill. The opening of the valve closes the connection of the main air-way and the groove with the oil reservoir. The valve thus becomes an intermittent lubricator, which oils the machine every time that the air is turned on and off. As the air is shut off frequently in drilling in order to change drills, to clean out the hole, etc., lubrication is frequent enough to be efficient.

This valve also has other merits, for it has two swivel joints, one where the hose is connected, and one where the valve



THE WESTERN LUBRICATING VALVE, MOUNTED ON A SMALL PISTON DRILL, AND IN SECTION

connects to the machine. This permits the easy removal of kinks in the hose, and enables the operator to keep the valve in a convenient position, no matter in what position the drill is turned. The conical shape of the valve and its being pressure-seated prevents leakage, which many valves now in general use are subject to unless frequently tightened.

The Western lubricating valve can be used on piston coal punchers, as well as on air drills. It is designed for use on any size of drill, whether of the piston or the hammer type, and is manufactured by the Western Lubricating Valve Company, 1416 Wazee street, Denver, Colo.

Electro-cyanide Processes

By Douglas Lay*

Successful results have attended the method of precipitating the precious metals from cyanide solutions by electrolysis of clear solutions. On the other hand, the attempts to electrically precipitate muddy solutions, so keenly persisted in by process inventors, have not been carried into successful practice on a working scale.

Many "electro-cyanide" processes of this type have been brought before the mining public of late years. These, while differing in detail of equipment, have for their aim and object precipitation of the precious metals during agitation of the finely ground ore and cyanide solution, in some kind of agitator or pan, in which are anode and cathode plates, suitably disposed, either horizontally or vertically. Among the claims brought forward regarding these processes, the most important are the following: (1) That precipitation of the precious metals is complete, or nearly so, during the period of agitation. (2) That the electric current plays a very important part in aiding the cyanide solution in dissolving the precious metals.

"An ounce of fact is worth a ton of theory." The claims referred to constitute the "ton of theory," the "ounce of fact" becomes abundantly manifest when one attempts to substantiate these claims in actual milling practice. To put it briefly, the "ounce of fact" is that precipitation of the precious metals is very incomplete, and that there is no material evidence as to the beneficial action of the electric current in aiding the dissolving of the precious metals. There must be some explanation of the failure of these "electro-cyanide" processes, in their most important point, the precipitation of the precious metals. In my opinion, an inquiry into the principles governing electro-deposition will convince one that the disappointing results obtained, on attempting to precipitate electrically muddy cyanide solutions in actual milling practice, are just what should be expected.

*Mining engineer, Silverton, British Columbia.

(1) Why Precipitation of the Precious Metals Can Take Place Only to a Small Extent

In my experience, the presence of solid matter in the electrolyte is not, *per se*, detrimental to precipitation; the only difficulties it introduces are mechanical, and will be referred to later. A perusal of textbooks might lead one to suppose that the rate of deposition of the precious metals could be governed by varying the current. It is essential to bear in mind, however, that the rate of deposition of any metal is only directly dependent on the current when the current finds abundance of metal to deposit, and when the percentage of metal in the electrolyte is kept constant. Such conditions would be adhered to were soluble anodes of the same composition as the metal being deposited employed, as in lead and copper refining; or, were constant additions of the metal being deposited made to the electrolyte, in the event of insoluble anodes being employed. In the electrical precipitation of cyanide solutions no such conditions prevail. Cyanide solutions of the strength used in milling practice are not electrolytes, within the meaning of the word. Moreover it must not be forgotten that the electrolyte undergoing dissociation is the double cyanide of gold (or silver) and potassium (or sodium), and that an extremely dilute solution of this is being electrolyzed. That being the case, it is quite hopeless to expect that precipitation can be controlled by varying the current, save to a very limited extent. Even if, by using a high-current density (say 1 amp. or more per sq.ft. of cathode surface) the precious metals could be precipitated very rapidly, there are reasons, which will be referred to later, precluding the possibility of employing such a current. A very low-current density must be used, certainly not higher than 0.1 amp. per sq.ft.

Conditions Governing Precipitation

The conditions which prevail are such that the extent to which precipitation takes place is practically entirely dependent upon the cathode area. The latter is of course dependent upon the size of the agitator or pan employed. It may be said that in an agitator capable of holding some 20 tons of ore and 30 tons of solution it will not be found practicable to put in more than about 650 sq.ft. of cathode surface. In the electrical precipitation of clear solutions, in my experience, a total cathode area of 1750 sq.ft. is required to precipitate ultimately a rate of flow of solution of 1 ton per hour. Assuming that as good results as this are obtained in the case of muddy solutions, and that a charge of 20 tons of ore and 30 tons of solution is agitated for a period of 8 hours: To secure complete precipitation of the precious metals in that time, a cathode area of $30 \times \frac{1}{8} \times 1750 = 6563$ sq. ft. would be required. It will be safe to assume that not more than 650 sq.ft. of cathode surface can be suspended in an agitator holding this charge. Therefore, only one-tenth (650/6563) of the precious metals in solution will be precipitated in the period of 8 hours. The results of exhaustive trials in actual milling practice have convinced me of the correctness of the foregoing theoretical consideration of the subject. Complete precipitation of the precious metals during a comparatively short period of agitation, with a necessarily limited cathode area, can never be realized in practice, because it is absolutely at variance with the principles governing electro-deposition. By unduly prolonging the period of agitation, and crowding the agitator with electrodes, I have managed in some instances to precipitate one-third of the precious metals in solution, but have never got better results than this.

(2) Does the Current Exert Any Beneficial Action in Aiding in the Dissolving of the Precious Metals From Their Ores?

We can conceive of two ways in which the current *might* exert such beneficial action: (a) By the generation of oxygen at the anodes. (b) By the regeneration of cyanide, owing to the double cyanides of gold (or silver) and potassium (or sodium) being split up into single cyanides by the current prior to the deposition of the precious metals, the single cyanides being then free to dissolve more precious metal from the ore.

To inquire into these arguments: (a) If the oxygen generated at the anodes is to exert any marked beneficial action, the generation must be an active one. As the amount of oxygen evolved at the anodes depends directly upon the current, and as a very weak current must be used, and therefore a small amount of oxygen only can be evolved, it is difficult to see how this can materially aid in the dissolving of the precious metals. It certainly could not compare with the aëration afforded by mechanical agitation.

(b) It is found in actual practice, that a small proportion only of the precious metals in solution can be precipitated. Hence, a small proportion only of the double cyanides can be decomposed, and consequently the regeneration of cyanide must be small.

Regeneration of Cyanide

Actual trials convince one that the electric current brings into play far more potent reactions tending to destroy, than to regenerate cyanide. For instance the following:

(a) Obviously carbon or base metal anodes must be used. Carbon is not con-

venient for the purpose, because it cannot be obtained in sufficiently large sheets. Of the base metals, iron, either sheet or cast, is most suitable, for various reasons. The action of the current is to oxidize and wear away the anodes. The resulting oxidation product reacts with the cyanide, causing a consumption of the latter. The fact that the anodes are being continually oxidized and worn away by the action of the current is one of the very strong reasons why a weak current must be employed. For the wear is directly dependent upon the current density.

(b) Lime, in the form of slaked lime, will be added, either prior to, or during, agitation, to neutralize any acidity present in the ore being treated. It may not be generally known, but it is nevertheless startlingly manifest in practice, that the electric current precipitates lime on the cathodes in the form of calcium carbonate, presumably owing to the generation of hydrogen at the cathodes. This action, needless to say, destroys cyanide, the carbon atom being taken from it. This is a two-fold reason for employing only a weak current, because the extent to which this action takes place is directly dependent upon the current strength. The action is harmful in two ways—firstly, it destroys cyanide, and secondly, this precipitation of calcium carbonate on the cathodes may seriously impair their receptive qualities, so far as the precipitation of the precious metals is concerned. For instance, if a high current density is employed, the cathodes will be rapidly coated with a dense deposit of calcium carbonate closely resembling boiler scale. Needless to say, no precipitation of the precious metals could take place on a cathode so coated.

Effect of Calcium Carbonate Deposition

It is probable that this deposit of calcium carbonate is responsible for a large amount of blame being attached to the solid matter in the electrolyte, viz., the finely ground ore. For instance the "electro-cyanide" process may start off fairly well. Precipitation of the precious metals does not by any means come up to expectations, but still it is evidently taking place. In the course of a few days, depending on the strength of the current used, precipitation gets less, and finally drops to zero. The cathodes are examined closely, and a scaline deposit is noted, the nature of which is not quite understood. It is accordingly loosely described as "foreign matter," and its presence is ascribed to the solid matter in the electrolyte. It is scraped off the cathodes, and a fresh start is made, resulting in the same deposit of "foreign matter" after a few days. After repeated trials, there is probably a heavy precipitation of profanity and much talk of zinc-boxes.

It is impossible to prevent this deposit of calcium carbonate on the cathodes, when lime is used to neutralize acidity. But there is no reason why it should impair the receptive qualities of the cathodes, so far as the precious metals are concerned, provided a weak current is used. In the electrical precipitation of clear solutions, I employ a current density of 0.02 ampere per square foot of cathode surface. The cathodes (lead sheets) are allowed to remain in the solution for one month. At the end of that time, while there is no appreciable depreciation in their receptive qualities, they are replaced by fresh sheets, as their surface is distinctly roughened, owing to the deposit of calcium carbonate.

(c) It is claimed that the oxygen generated at the anodes aids in the dissolving of the precious metals. Why should it not be just as likely to oxidize and destroy cyanide?

Mechanical Difficulties of Precipitating Muddy Solutions

There are certain mechanical difficulties, the overcoming of which causes endless trouble. Prominent among these are the following:

(1) It is essential that the surface of the cathodes be absolutely oxide free. The surface, once so prepared by scouring and immersion in a reducing solution, must on no account be allowed to dry. The cathodes must always be kept wet. A difficulty is introduced by precipitating in an agitator, or pan, by reason of the necessity of periodically discharging the contents. However little time be taken up with this operation, the cathodes dry and oxidize to a certain extent very rapidly, and their receptive qualities are impaired to a corresponding extent. This depreciation of the active surface of the cathodes is further increased by slime drying on them, during the time occupied in discharging and recharging the agitator.

(2) The nature of the operation necessitates the anode connections being entirely below the surface of the solution. Special means have to be taken to insulate these thoroughly, or they will be rapidly eaten away by the action of the current.

(3) Given even a clear solution, a pan or an agitator would not be a suitable container for electrical precipitation, because there is no way of gradually ionizing the solution under treatment, and so getting the best results from a weak current. This gradual ionization of the solution is best effected by causing it to flow through a long rectangular tank, or tanks, containing a large active cathode area. The solution thus becomes more and more ionized as it reaches the outlet end of the tank.

Amalgamated Cathodes

In those cases where amalgamated cathodes are employed, it is quite easy to understand that the electric current might get undue credit. A certain proportion of the precious metal contents of the ore under treatment will simply be amalgamated without passing into solution first. The current would in such a case, be responsible for only a portion of the precious metals deposited on the cathode.

Inasmuch as there must finally be a separation, either imperfect by decantation, or perfect by filtration, of solid from liquid matter, in order to recover the cyanide solution, it is extremely difficult to understand the reason for attempting precipitation until this separation has been accomplished. No one would dream of attempting to precipitate muddy solutions by means of zinc, and practical experience demonstrates that there is about as much justification for so doing, as there is for attempting to precipitate electrically under such conditions.

Tapping Mine Water Under Great Pressure

By Robert Sibley*

In the Journal of March 14, I described the proposed tapping of 110,000,000 gal. of water standing with a head of 935 ft. in the Iron Mountain mine, Montana. Every detail of the tapping took place, March 12, exactly as planned. It was undertaken first with a 3-in. drill which was sent in 10 ft. This hole was lined with an iron pipe, anchored and cemented in. The inside of this pipe was 3¾ in., and through this the last drilling was done, a 1¾-in. drill being used. Just as the chuck of the drill struck against the face of the drift, the drill stuck. It was in 23 ft. and it was the longest piece of steel that the men had. The drill was uncoupled and moved out of the way and with a wrench the men started to loosen the steel from the grip of the rock. After two or three twists, the wrench and the drill were wrested from the hands of the men and the drill shot into the timber bulkhead at the back end of the tail drift. The water had been tapped.

The stream of water followed the drill and spurted the length of the drift, but the pipe held in place and did not furnish enough water to do any damage.

After seeing that everything was all right, the men started out, leaving the water running with the steadiness of a stream from a city spigot. Across the entrance to the side drift a dam had been constructed. Over this dam they climbed as the water reached it. They mounted the "get-away" car and easily reached the surface.

*Hydraulic and electrical engineer, Missoula, Mont.

The Pittsburg Coal Company

This company owns and operates extensive coal properties in the Pittsburg district of Pennsylvania and the Hocking Valley district in Ohio. It is a consolidation, made in 1899, of a number of companies operating in those districts. The present report covers the year 1907.

The capital stock is $32,000,000 preferred and $32,000,000 common; of which $4,928,200 preferred and $3,895,400 common stock is in the company's treasury. The bonded debt and secured obligations amount to $24,967,977. In addition to property owned, the company holds $8,047,832 in stocks and bonds of other companies.

The statement of coal lands owned and leased is as follows, in acres:

	Pittsburg District.	Hocking District.	Total.
Owned	186,221	8,215	194,436
Leased	24,225	2,033	26,258
Total, Jan. 1	210,446	10,248	220,694
Added in 1907	1,157	12	1,169
Total	211,603	10,260	221,863
Worked out in 1907	2,748	190	2,938
Total, Dec. 31	208,855	10,070	218,925

This shows a net decrease of 1769 acres of coal land reserves during the year.

The coal statement for the year is as follows, in short tons:

	1906.	1907.	Changes.
Pittsburg district	18,175,280	18,005,382	D. 169,898
Hocking district	1,415,920	1,348,112	D. 67,808
Total coal mined	19,591,200	19,353,494	D. 237,706
Coke made	429,076	456,933	I. 27,857

Of the coal mined in 1907 there were 579,833 tons used in making coke; an average of 1.27 tons coal to the ton of coke. The average prices obtained for coal were higher in 1907 than in 1906, and there was an increase in earnings, though coal production decreased 1.2 per cent.

The income account for the year is as follows:

Net earnings, after deducting working expenses and repairs	$5,731,983
Reserve for depletion of coal lands	$ 725,937
Reserve for depreciation plant and equipment	964,809
Interest on bonds	1,082,644
Total charges	$2,773,390
Net surplus	$2,958,593
Special adjustments	59,001
Balance	$2,899,592

Adding balance from 1906, there was a total at the end of the year of $6,988,803 undivided profits. No dividends have been paid since February, 1905. The increase in net earnings over 1906 was $434,860, or 8.2 per cent.

The report says, in part: The net working capital of the company, being the surplus of apparent quick convertible assets over the floating indebtedness at the close of the year after large payments in the retirement of funded dept is $4,298,190, being an increase of $2,692,043 over the balance at the close of the preceding year. Stocks of coal on hand and supplies carried show increases, owing to provision being made for a continuance of tonnage demand usually had in the last three months of the year which failed this year on account of the change in general conditions.

Royalties reserved by charge against operating expenses, being 5c. for each ton of run-of-mine coal taken from properties owned, amount for the year to $725,937. The portion of this amount paid into bond sinking fund, together with proceeds received from the sale of this company's interests in the Milwaukee-Western Fuel Company, of Milwaukee, and of the C. Reiss Coal Company, of Sheboygan, Wis. —which was authorized at the last annual meeting of shareholders—effected the retirement during the year of $2,081,000, par value, of first-mortgage bonds, upon which premium was paid in the sum of $140,952 amounting to $2,221,952; the total retirement of such bonds to date being $3,820,000 or 15.31 per cent. of the total issue. Since the sinking fund payment has retired 2434 bonds of the total on an exhaustion of 6400 acres of coal rights and there yet remain of such coal rights at date of the report 193,965 acres, it is to be noted, based on the royalty payments of the past, that but about 55,691 acres or 28.7 per cent. of the coal owned will be required for the total extinction of the first-mortgage bonds.

Total expenditures for new plants and equipment during the year were $969,029. The policy of setting aside from earnings into renewal fund an aggregate sum equal to six per cent. per annum on the value of all of the company's plants and equipments, has been continued during the year, $964,809 being so reserved. This reservation has been sufficient, within $4220, to cover all expenditures made for new plants and equipments and for renewals, expenditures for ordinary maintenance and repairs being charged direct to operations. It is believed that a continuation of this scale of renewal provision will be sufficient to keep up fully the efficiency of the plants and equipments, and measurably increase the same without creation of new debt or encroachment upon working capital. The physical condition of all of the mines of the company has been fully maintained, and development work has more than kept pace with actual mining requirements.

During the year there were completed 390 coke ovens, making the total number owned and ready for operation at date of this report 1119. Owing to the fact that many blast furnaces temporarily went out of commission, the operation of all of these ovens was suspended about Dec. 1, but it is expected that in the near future the business conditions will so have improved as to make it possible to then operate them to their full capacity on a profitable basis.

The work of the Pittsburg Coal Company Employees' Association, organized in 1900 for the purpose of encouraging and assisting employees in the purchase of stock of the Company on monthly payments, has been continued through the year on the ground of mutual benefit.

During the year there were two conventions of mine employees representing all the branches of the Mine Employees' Accident and Death Association. As a result of these conventions, it was decided to change the form of organization under which the coöperative work of the company and its mine employees in relief distribution should be continued, by organizing the same into a department of the company's service to be known as "Relief Department;" the government of which to vest in an advisory committee of seven members, three of whom to be annually elected by the mine employees, three appointed by the company's directors; the general manager of mines of the company to be the seventh member and chairman ex-officio. The relief payments for the year were: Benefits, $98,332; pension fund, $8603; expenses, $11,223; total, $118,158. Of this sum the employees contributed $90,659, and the company $27,499. There were 17,618 employees contributing.

The company has organized an insurance department, and will hereafter carry all its own risks.

Sheffield Coal and Iron Company

The reorganization committee of the Sheffield Coal and Iron Company has completed its plan and agreement for the reorganization of the company and submitted it to the bondholders and stockholders. It provides for the organization of a new corporation under the name of the Sheffield Iron Company, to have an authorized issue of $750,000 first-mortgage 20-year 5-per cent. gold bonds; $750,000 in 6-per cent. non-cumulative preferred stock and $2,500,000 common stock. Unless otherwise determined by the committee the consummation of the plan is conditioned upon subscriptions for the amount of $500,000. The plan provides further that stockholders subscribing the new money will receive bonds and preferred stock at the same rate as the present holders of both classes of bonds (who come into the plan at the amount their bonds cost them) and they will at the same time receive new common stock in the same proportion as their present stock holding. The bonds of the company are to be taken in at the amounts of the loans, and interest, for which they were held as collateral.

In English collieries the breaking of shackles on couplings between tram cars is a frequent cause of accident. Under present practice the coupling is used until it breaks and agitation is now under way for periodical inspection and testing.

Turbine Fans in Mine Ventilation

By Daniel T. Pierce

Representatives of various companies and several manufacturing concerns, lately witnessed tests of a mine fan installation of novel type, at the Ellsworth collieries, Ellsworth, Penn. Although the arrangements for the tests were not entirely satisfactory, especially in respect to the form of the discharge, the outcome was indicative of the results that can be obtained by modern high-power fans of the turbine type. With an evase discharge fitted to the outlet of the fan, W. R. Calverley, superintendent of the Ellsworth collieries, said that the results would have been still better. A mechanical efficiency of 68 per cent. was reached, and it is reasonably certain that when the installation is finally completed, the average efficiency will be found to exceed 70 per cent.

The following table gives the results of this test on a 75-in. double-inlet Sirocco reversible fan; the machine was chain driven by two 200-h.p. motors. Tests were made Jan. 27, 1908, at the Ellsworth Coal Company's plant at Ellsworth, Pennsylvania:

Time.	R.P.M.	Amperes.	Volts.	Volume in cu.ft. per Min.	Water Gage in Mine.	Water Gage in Casing.	H.P. in Air.	Contents of Wheel.	Output per Revolution.	Combined Mechanical Efficiency of Fan Motors and Double Chain Drive. Per Cent.	Mechanical Efficiency of Fan. Per Cent.	Volumetric Efficiency. Per Cent.	Manometrical Efficiency. Per Cent.	Tip Speed Peripheral.	H. P. in Motor.
1:15	265	{ 107 / 107 }	500	180288	2.1	0.4	59	216.6	680	40	51	317	65	5194	144
12:00	338	{ 215 / 210 }	532	295600	3.6	0.7	167.6	216.6	874	55	69	407	68	6624	303
1:35	386	{ 378 / 295 }	500	359800	4.4	1.0	249	216.6	932	55	68	434	62	7565	451

The Fan Blades

The Ellsworth installation, with which the above tests were carried out, requires little explanation in addition to the accompanying diagrams. The fan runner itself is practically identical with the construction of the standard type of Sirocco centrifugal fan employed for general ventilating purposes. To suit the more severe duties of mine work, however, both the casing and the runner are built of heavier material, and the runner is of the double-inlet type, that is, what amounts to two single fans placed back to back. Unlike centrifugal fans of the style heretofore in general use, the blades of the Sirocco blower, from the inner to the outer edges, measure less radially than their face measurement parallel with the fan shaft, and the 64 blades in each drum take the place of the 12 blades or less, ordinarily employed in centrifugal blowers.

Air Velocity Exceeds Peripheral Speed

By curving the tips of the blades forward in the direction of rotation, the velocity with which the air is discharged exceeds the peripheral speed of the tips of the blades by as much as 70 per cent. This is an important factor to be considered in connection with mechanical efficiency.

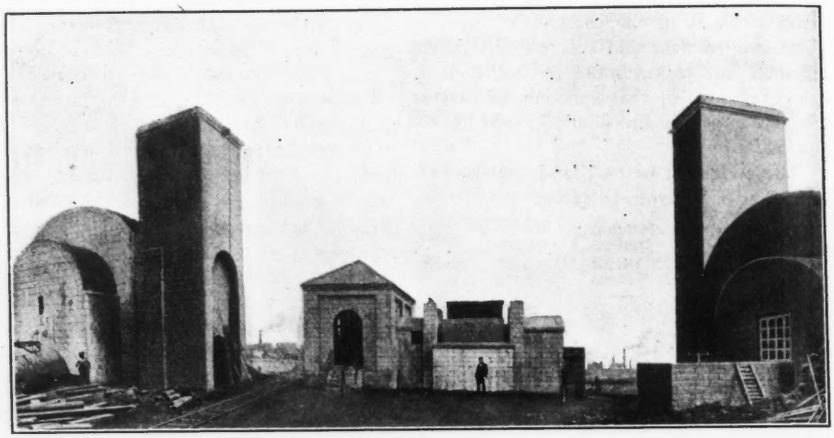
If, for example, as was shown in the tests of a 25-in. fan in actual use, the tips of the blades at 300 r.p.m. have a speed of 1962 ft. per min., it is necessary to add 70 per cent. to this speed in order to get the actual velocity of the air. In this case the volume of discharge, 8000 cu.ft. per min., must therefore, be figured at a velocity of 1962 ft. plus 70 per cent., or 3335 lineal feet per minute. This affords a proper basis for computing the degree of efficiency per unit of power consumed.

An Interesting Installation

While turbine fans of the Sirocco type are generally used in the ventilation of English coal mines and for similar installations on the Continent, there are but few of them to be seen in this country, as they have only recently been introduced and manufactured here. The use of Guibal fans, the design of which has changed but little during the past 25 years has elapsed since Guibal's death, but is still general throughout the Pennsylvania anthracite regions.

A particularly interesting installation is that at the Pelton colliery, in Durham county, England, where a single Sirocco fan is used alternately with two Guibal fans to ventilate the same mines. The drifts are so arranged that the Guibal fans when in operation for one period of 12 hours serve one mine each, while the Sirocco fan, when it alone is employed for the remaining 12 hours each day, deals simultaneously with the ventilation of both mines.

The most striking feature of this installation is that while the two fans of old type measure 30 and 36 ft. respectively, in diameter, the Sirocco, with an output in excess of the two Guibal fans, measures only 75 in. in diameter. The accompanying illustration gives a better idea of the great difference in cost of installation in favor of this newer type of fan.



VENTILATING FANS, PELTON COLLIERY, DURHAM COUNTY, ENGLAND

Ramming rods that have become worn round at the end tend to penetrate the cartridge and force out part of the contents; this causes the powder to mingle with the coal dust when the rod is being withdrawn, thus increasing the possibility of a misfire.

There are no workmen in France better protected by law than miners. Their pay is high, and in addition they get bonuses, free coal, cheap lodgings, free doctor, free medicine and a pension. The wives and children of miners are looked after and their existence is made more agreeable than those in similar walks of life.

*Tribune building, New York City.

Caught in a Coal Mine Explosion

By R. M. Downie*

The terrible holocausts which have recently occurred at Monongah, Jacobs Creek and in other mining districts, have called attention anew to the dangers connected with mining. It is well known that all of the coal mines affected, are daily inspected by State or company experts. It is the business of these inspectors to visit all parts of the mine and report upon its safe working conditions. Certain instruments are used to determine the amount of combustible gas present, but that these appliances and precautions are ineffective is proved by the rapid repetition of these terrible disasters.

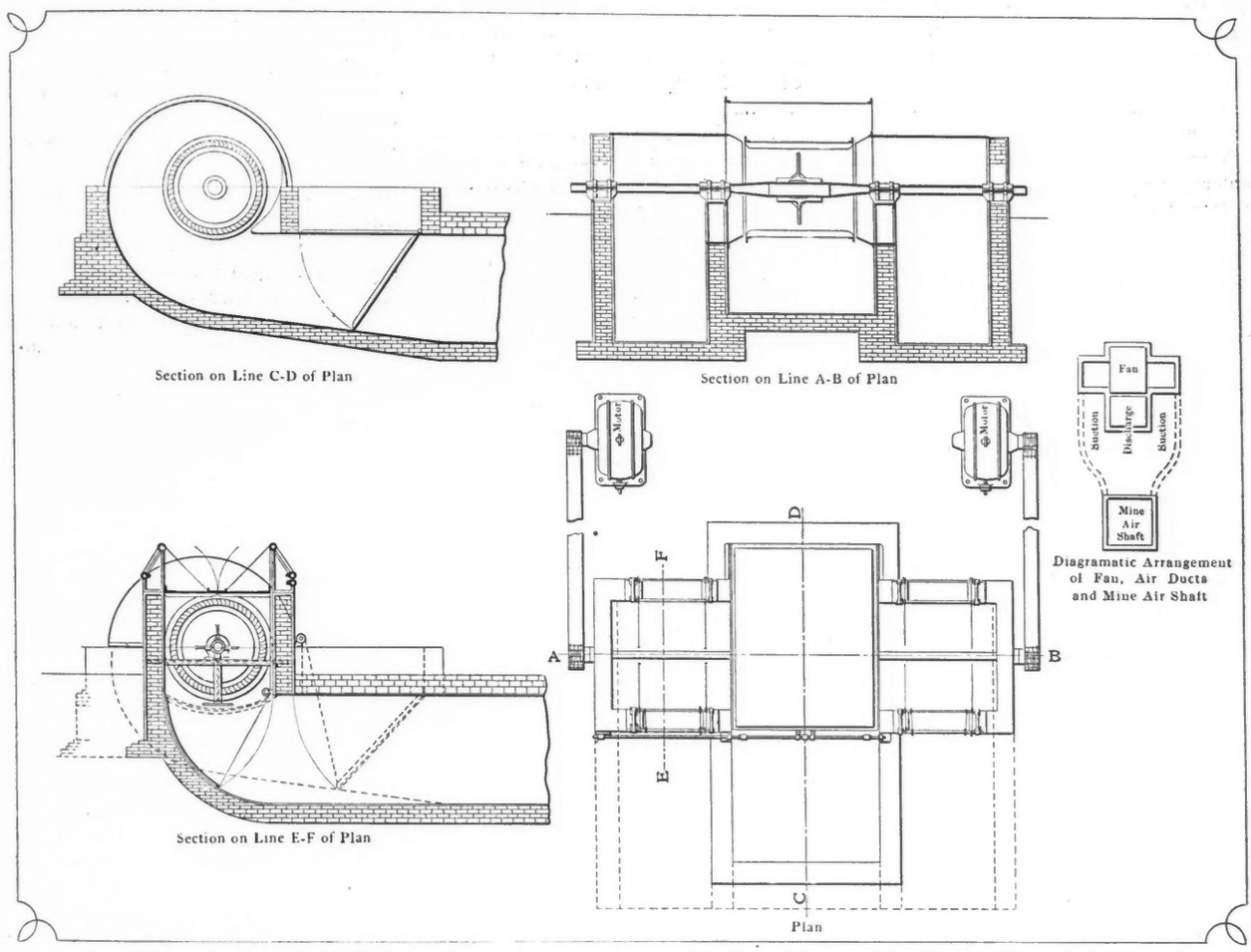


DIAGRAM SHOWING ARRANGEMENT OF 75-IN. SIROCCO FAN AT ELLSWORTH COLLIERIES, ELLSWORTH, PENN.

Gas Ignited

No pointed description can convey a realization of what one of these explosions mean. Some years ago, while inspecting a coal mine at Salineville, Ohio, I was caught in one of these accidents and will never forget the experience. With the mine superintendent and another gentleman, we penetrated a half mile or more to a portion of the mine containing some abandoned rooms. Entering one of them some 200 ft. long and 25 ft. wide, we were assured by the superintendent that the mine was clear of gas and perfectly safe. A heavy fall of slate in the abandoned room had left a dome like cavity in the top of the roof in which had collected probably 2000 or 3000 ft. of gas. This gas being lighter than air probably filled the cavity left by the fallen slate. The superintendent was leading the way with an uncovered lamp in his cap. We all seemed to be safe until the superintendent mounted the fallen slate, but upon so doing, his lamp was elevated into touch with the gas strata. The latter being as yet unmixed with air did not burn instantly, but a little spiral column of blue flame arose from the naked light and spread out like an unbrella against the rock roof.

Action of the Explosion

As is well known, gas, unmixed with air, is non-combustible and will not burn at all, but the upward draft from the heat of the lamp carried just enough oxygen to produce the umbrella like flame. Then, in turn, the agitation caused by the burning of this small quantity of aërated gas mixed a larger volume of air with more of the gas, and in the space of about 2 sec. after the flame had spread on the ceiling, an explosion took place violent enough to throw our companion about 10 ft. and into a pool of water. The superintendent, however, understanding the matter better than we, upon the first flash of flame had dropped to the floor and buried his face in his hands.

At the moment of the explosion, I was some 30 or 40 ft. to the rear and just inside the door of a room; although the force of the explosion was fully felt, I managed to remain on my feet. It was a new and exciting experience, and not knowing what else to do, we instinctively faced about for the main entry. At this instant, the third and real explosion came. The second one had mixed the air and gas in the entire room and it apparently all went off at one instant of time. The force of this last explosion appeared to lift us bodily off our feet and shoot us through the doorway like a wad out of a gun. It flattened us up against the wall of coal on the opposite side of the 10 or 12 ft. main entry. This flying trip probably required but a second or two, but it was long enough to satisfy us fully with that kind

*Beaver Falls, Pennsylvania.

of locomotion. As we passed through the door in a current of rushing, deafening blinding flame, we of course supposed our end had come. The time seemed to occupy minutes.

A Narrow Escape

The intonation of the explosion was something fearful and beyond all comparison. The first violent report had not yet died out, when echoes of it, scarcely less loud, came back, seemingly from all directions. Then came the re- and re-echoes from farther and farther parts of the mine like the booming of successive and receding batteries of deafening cannon. Our escape was due to two things, one a condition and the other an accident:

The condition was that gas had accumulated in only the one room. The accident consisted in the fact that, in this particular room, a great volume of water percolated from the roof freeing it from all coal dust. For these reasons the explosion did not spread to any other parts of the mine.

Immediately after the explosion, there was a back rush of fresh air which rescued us from suffocation and enabled us to again breathe. The superintendent's clothes were afire as was also a rather damp morning newspaper in my overcoat pocket. Devoid of whiskers, eyelashes and hair to our hat-lines, with blistered faces and hands, we lost no time in returning to the upper world and a drug store. We were no little surprised at the light way in which the superintendent spoke of the matter. He spoke of it as a "puff" and left us with the impression that such things happened frequently.

The Combustion of Gases

There are some facts about the combustion of gases and dust which are not well known. All gases are not the same. There are almost as many compositions of these as there are of liquids or solids. Natural gas, for example, is a hydrocarbon, and in the state in which it issues from the ground, or comes into coal mines, and in the state in which it is supposed to be delivered to consumers, it will not burn at all. It must be mixed with some proportion of oxygen or air before it can be ignited. To make ordinary natural gas burn it must be saturated with from 4 to 16 times its bulk of air. If the gas is mixed with as much as 20, 30 or more times its bulk of air, it becomes too thin to burn. It would therefore be possible for a gas company to pump or "syphon" 300, 500 or even 1000 ft. of air into its mains for each 1000 ft. of gas issuing from its wells with comparative safety and the consumer would never know the difference unless he analyzed it at his faucet. On the other hand, if the company should force into their mains as much as 5000 ft. of air for each 1000 ft. from the well, the result would be an explosion that would probably blow up every pipe in its system of mains.

Conditions That Cause Explosions

In almost every coal mine there exists at least a little gas mixed with the air. A little of it, say one, two or three parts in one hundred will not seriously affect the miner. He can live and breathe in it without much discomfort. The purpose of ventilating a coal mine is not to supply fresh air to the miner so much as it is to drive out the powder fumes and prevent the accumulation of more than 1 or 2 per cent. of gas. This 1, 2 or 3 per cent. of gas would contain no element of danger whatsoever were it not for the dust. But if this dust, (caused by blasting or breaking up the dry coal) be present in the mine, even small quantities of gas become exceedingly dangerous. A blast, a little flash of gas, or the striking of a match may set it off.

In reality, it is not the gas which does the damage in these great coal mine explosions, but the coal dust. Many mines are dry and the floors of the rooms may be covered with settled dust. While this dust remains on the floor, it is comparatively harmless, and its presence may not be noticed, or, if noticed, wholly neglected as harmless, and the mine be declared safe by the fire-boss. But a new current of air from the ventilating fans, a blast or other circumstance may in a few minutes "raise dust" which contains all the conditions for a disastrous explosion. This initial explosion may agitate the dust of a still larger area of the mine causing a second explosion, or in turn, a third.

The common method of ventilating coal mines is most defective and the wonder is that there are so few disasters. Driving a current of air, no matter how strong or constant, through a long system of workings does not effectively remove the dust. It may sweep it from one room to deposit it in another, or carry it from the operated headings to drop it in the abandoned chambers. Here it may collect until mixed with a little incoming and scarcely detectible quantity of gas and the room in which it is contained then becomes a huge magazine of gunpowder.

After the initial explosion, gas is not always needed to produce additional, greater or farther reaching successors. Once started, the coal dust afloat or stirred up, is, without a particle of gas, capable of sustaining combustion. It is even possible to initiate an explosion with coal dust, if the latter is sufficiently dry and fine. Explosions have been caused by the dust from sand-papering machines, flour mills, etc. A few years ago a large flouring mill at Minneapolis was blown to atoms by the ignition of the wheat flour afloat in the air. However, the danger from dust alone is not great if there be no gas to start the combustion.

Suggested Remedies

An effective remedy in the form of proper ventilation, is easily suggested and if carefully applied would forfend these calamities. At short intervals, vents should be made to the surface, shafts or large drill holes. These would form self-operating chimneys to draw off the gas and dust as they accumulate. This would also effectually prevent the recurrence of such disasters as those at Monongah or Jacobs Creek. Explosions are always worse and occur with more frequency in older mines where there are a lot of abandoned rooms partly filled with "gob" or piles of refuse "stock." In these, the gas and dust have every opportunity to collect. The inspector perhaps rarely visits them, confining his investigations to the headings in present use. The vents I suggest can readily be made so as to be permanently operative in these abandoned workings, and once in place would require little attention.

In the average mine, one vent costing say $200 to $300 would be sufficient for probably each 3000 tons of coal mined, or say 1 c. per ton. This would not be too much to pay for the great additional safety that would be secured. One vent would serve for several adjacent rooms perhaps. And in the event of a cave-in or explosion, a mine thus equipped could be explored from the surface, from one end to the other. If any of the entombed miners should still be living they could be located by a previously adopted code of signals, and air, food, clothing or water could be conveyed to them. There is nothing which strikes people with such horror as the suspicion that a human being has been buried alive, or that 50 or 100 men may be suffocating or starving to death within a few rods of most willing but wholly helpless aid.

Of course, there can be objections raised to the above plan, such, for example, as that the boring of such vents would let in the water and cause extra pumping. This, however, is a small matter, for in the aggregate, the quantity of water would not usually be increased. But even this could be obviated in nine cases out of ten by setting a casing in a good bed of hydraulic cement, where it passes through the roof.

The tendency of a mine fire is to surround itself with an atmosphere of noncombustible gases, which act as a protection against explosions of firedamp, if the air current is so arranged that it will carry the firedamp away from the fire.

The fire boss should walk with the air current and not against it when making an examination, then if his light goes out when he enters gas, he can safely retreat and relight his lamp at such a point as he has ascertained to be free from gas.

Colliery Notes, Observations and Comments

Practical Hints Gathered from Experience and from the Study of Problems Peculiar to Bituminous and Anthracite Coal Mining

DEVELOPMENT AND MANAGEMENT

The coals of east central Carbon county, Wyoming, range from poor to high-grade bituminous. They are as a rule bright, brittle, and non-coking. The best coals in the area are found in the formation called by the geologists the Mesaverde, which contains also the high-grade coals of the field in Routt county, Colo.

The common practice among miners, of forcing the cartridge into the hole with the butt end of their drills, of cutting the match on the squib too short, of handling powder with lamps on their caps, of untwisting the match, and of soaking them in kerosene, are fruitful sources of accidents and should be positively forbidden in all mines.

Safety lamps with brass gauze are to be suppressed at Neuveglise, France, and iron ones adopted. Ignited lamps with brass and iron cylinders were exposed to fiery mixtures of 2, 3 and 4 m. per second velocity. At 3 m. the brass accumulated in little drops at some places and holes formed; at 4 m. they melted completely. Iron on the contrary was quite unaffected.

A 15-ft. seam of gas-making bituminous coal has been found in Stone cañon, Monterey county, California. The coal is hard and will stand transportation. It contains little moisture, but considerable sulphur, and is considered the best coal on the Pacific coast south of Washington. Investigation shows that it was formed in early tertiary time, long after the formation of the coal beds of the eastern and interior States.

From tests made in France, the conclusion has been reached that the contents of a blasting cartridge may become mixed with coal dust in shot holes if the cartridge covering is broken in tamping; under these conditions, deflagration of the mixture may occur, and if fire damp is present, it is almost certain to be lighted. It is advisable therefore, that all shot holes bored in standing coal should be carefully cleaned of dust, and the practice of ramming a cartridge hard enough to break the envelop should be avoided.

In 1906, according to the U. S. Geological Survey, 3,846,501 long tons of anthracite were reclaimed from old culm banks in Pennsylvania. Both the amount of this recovery from the culm banks and the percentage that it bears to the total shipment were larger in 1906 than in any previous year. Nearly all of this is, of course, small-sized coal used for steam purposes, but this recovery from old culm banks is exerting a considerable influence on the total production, amounting in 1906 to nearly 7 per cent. of the total shipment.

In the early years of anthracite mining the gangways and airways were generally driven 9 ft. wide and 7 ft. high so as to get the maximum safety from the roof falls with the use of as few props as possible. These dimensions hardly gave sufficient room for the drivers, mules, etc. In recent years the dimensions have been increased until they are usually 14 to 16 ft. wide and 7 ft. high. This increase in the sectional area of the haulways reduces the friction in the ventilating current and gives sufficient room for drivers and mules when a loaded trip is on the road; as a consequence, the percentage of haulway accidents to men and beasts has been reduced.

The natural commercial market for coals from east central Carbon county, Wyoming, is limited on the east by Omaha, on the west by Rawlins, on the north by the Black hills, and on the south by Denver. The western outlet is today blocked to a large degree by the higher-grade coals of Sweetwater and Uinta counties. At Denver the Carbon county coals come into competition with the Colorado coals, at Omaha with those of the Interior basin, and at the Black hills with the Newcastle and Sheridan coals. The development of the metalliferous deposits in the ranges surrounding the basin may create a considerable local demand for this coal.

Owing to the close control that is now exercised over the production of anthracite, and the regulations fixing the price, the average values per ton have not varied materially during the last three years. In 1904 the average price per ton at the mines was $2.35; in 1905, $2.25, and in 1906, $2.30, these variations being due largely to the varying percentage of small and large sizes sold. In 1903, after the strike, the average price per ton at the mines was $2.50. This value includes not only the prepared sizes with which householders are familiar, such as nut, egg, stove, etc., and which are sold at much higher rates, but also such sizes as buckwheat, rice, barley, etc., some of which are sold considerably below the actual cost of mining.

Breathing apparatus for fire fighting, according to Prof. Leonard Hall in an address delivered before a recent meeting of the North Staffordshire Institute of Mining and Mechanical Engineers, should be capable of supplying two liters of air per minute for two hours. The absorber must be sufficiently efficient to keep the oxygen in the air above 12 per cent. and the wearer should have warning of the falling off in the air supply. The percentage of carbon dioxide should not be allowed to become greater than 3 per cent. The breathing bag must be large enough to furnish plenty of air for one breath. The weight of the apparatus should be so distributed as not to make the wearer clumsy and it should be as light as possible.

Regarding the commercial development of coal in the field on the western edge of the Rocky mountains in Wyoming, just east of the great Grand river field, George R. Black, superintendent of the Union Pacific Coal Company, states: "The first mines opened in Carbon county, Wyo., and worked to any extent, were opened by this company in 1868 at and near the town of Carbon, the last one being abandoned in 1902. There were seven of them. While the coal is not of the best, it is certain that the mines in that vicinity would still be working had not the main line of the Union Pacific Railroad passing through Carbon been vacated and taken farther to the north, where it passes through the Hanna coal. The mines at Dana, Carbon county, were opened in 1889 and abandoned in 1891 on account of the coal sparking too badly for locomotive use. The Hanna mines were opened in 1890 and are still in operation."

In utilizing waste steam to heat and purify feed water, one plan is to lead the waste steam from the winding engine through an oil separator, which removes the oil and cleans the exhaust steam before it enters the heater where it is condensed by coming in contact with cold, hard water which flows over a series of special trays. The water formed by condensation is thus heated to a little over 200 deg. F., and its hardness is reduced by dilution with the pure condensed exhaust steam; at the same time, the heat of the waste steam drives off the air and gases and arrests the temporary hardness without chemical treatment. To avoid permanent hardness, a solution of soda ash is automatically fed with the cold water. This system of supplying boilers with hot, soft water and protecting them from oil and scale increases their capacity in some cases as much as 20 per cent. besides effecting a fuel saving of about 15 per cent.

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Contents

The Transportation Problem

The question of transportation, and therefore of highways and waterways, as well as railroads, becomes the more urgent the more restless our people become and the greater the bulk of traffic, to meet the growing complexity of our industrial life. Water transportation was all important before the introduction of the railroad. With the introduction of the railroad, capital and science were both deflected from our waterways, whether artificial or natural, to the creation and improvement of our iron roads, which explains some of the anomalies which puzzle the public.

The President in a recent message seems to blame the railroads, which at present are the scapegoats on whose head it is popular to pile almost every shortcoming of the body politic, for destroying the water traffic of the Mississippi by lowering rates so as to compete with water transportation, and securing the waterfront adjacent to the large cities. There is no doubt that railroads when brought into competition with water transportation do make protective tariffs so low that there can be but little profit derived from this competitive freight traffic, and that therefore inland tariff rates must be raised so as to compensate them. It cannot, however, be maintained that the railroad really reduces rates below the steamboat rates. Consequently when the public is offered at approximately the same rate transportation of freight by rail or steamboat, and chooses the former, it is because it prefers for obvious reasons the rail. And therefore, we imagine that the population along the river would resent the compulsory raising of railroad rates in order to prevent railroad competition with that of the steamboat.

The truth is that inventions and their application run in cycles, and that when a great revolution such as that made by railroads takes place, the energies of the world are directed inordinately to its development and other means of attaining the same end or object are neglected. In time, however, the balance tends to be restored and attention is redirected to industrial subjects and methods which were temporarily obscured by the glamor of the greater revelation. Had one-tenth of the inventive force and of the capital been directed during the last half century to the improvement of our canal system, and not only to the deepening and protection of our great waterways, but likewise to the steam vessels for effecting transportation upon our canals and rivers, inland water transportation would be in better position today to compete on more equal terms with the railroad. It is not through any malicious or selfish set purpose of the great railroad companies to throttle competition that the present decay of fluvial navigation has taken place, but in obedience to some such influence as we have pointed out. That this is true is well exemplified by the disproportionate advance made in the means of transportation by sea as compared with those provided for canal and river navigation. Undoubtedly it is high time that our waterways be improved, and that the current of capital and enterprise be deflected toward them and their floating equipment.

As a further corroboration of the above proposition may be cited the neglect of public highways for a time after the replacement of the stagecoach by the railroad car; but now that the automobile is in a fair way of displacing to a certain extent the locomotive, public attention will unquestionably be deflected from the railroad to the highways; and men's wits will have to be expended in improving them, and devising in fact some new method of building our public roads.

In a paper in a recent *Journal of the Society of Arts* on the problem of road construction with a view to modern and future requirements, Dr. H. S. Hele-Shaw, in describing the elastic roadbed as built under the Gladwell system, gives some interesting statistics. He says with regard to Great Britain "Under the changed conditions today, the increased expenditure has been so great as justly to alarm the county and borough councils, urban and rural authorities, and other bodies throughout the whole country responsible for the use of the roads. Thus the increase of cost in main roads, in 13 years, from 1892 to 1905, had risen from one and a half millions per annum to two and a half millions, or an increase of 66.66 per cent. The urban and rural roads between the 12 months ending March 31, 1896, showed the cost of 25,650 miles of main road to be £1,778,791., or £68.34 per mile; ten years later (that is last year), the cost of 27,380 miles of main road was £2,478,481, or £90.51 per mile, being an increase of 30.51 per cent. Taking specific cases from three counties—Hertfordshire, Essex and Berkshire—the increased cost per an-

num per mile of road was, in one case, from £97 to £193; in another case, from £76 to £168; in another case from £101 to 170; and in another case from £63 to £99. In the county of Hampshire the cost of maintenance has risen in 10 years from £28,000 to £65,000. In the county of Kent, in seven years, the macadam used has risen from 41,531 tons to 69,275 tons."

That the same increase in expenditure has not shocked us and increased our taxation is simply because we have allowed our roads to fall into such disrepair that before long they will have to be remade or the motor abandoned. The latter alternative certainly will not take place, and therefore the same deflection of engineering skill and money which we have seen turned from steamboats to railroads will have to be, to a less degree, directed from railroads back to ordinary highways. And so with the origin of new wants have to be created new means of gratifying them, and now and then the curve of invention returns almost to the initial point.

The New Mining Society

A meeting for the organization of the new mining society, to which we have previously referred, is to be held at New York, April 20. The movement having thus gone so far, and having departed more or less from original intentions, it is well to consider calmly what is to be done and what may result.

Passing over the original suggestions of Dr. Chance, the movement became one for the organization of a strictly professional society on the ground that the American Institute of Mining Engineers, because of its catholicity and liberality in admitting members, had ceased to be such. Moreover, the new society was to impose substantial qualifications for membership, similar to those of the American Society of Civil Engineers and the Institution of Mining and Metallurgy.

It is unnecessary at present to discuss the sphere of activity to be entered into by the new society or its projects for the advancement of professional interests. It is sufficient to say that a large number of representative geologists and engineers conceived that the proposed society would serve a useful purpose and accepted invitations to become charter members. Nearly all of these gentlemen are members of the American Institute of Mining Engineers, and many of them entered the new society with the understanding that it was to be confined to a distinct sphere and was not to encroach upon that of the Institute or detract from the ability of the latter to fulfil the special functions which it has done during its honorable and useful career of 37 years. On the other hand, a number of distinguished engineers, considering that the new society would inevitably have an adverse affect upon the Institute, refused to accept the invitations to join it.

The proposal was then made that the new society incorporate in its constitution, among the qualifications for membership the provision that candidates should be already members of the Institute, and should continue to be, so long as members of the new society. This would absolutely safeguard the Institute. It would practically make the new society an organization inside of the Institute, but in its title, government and actions it would be entirely independent. This proposal met with some favor, but also with some opposition, the opponents being in the majority. In the course of these conferences and expressions of opinion there developed considerable criticism of the Institute, and the willingness, nay the desire, to create a rival society. What may be called a moderate opinion was that the interests of the profession demanded a new society, which it was hoped might affiliate with the Institute, but if that were impossible the interests of the Institute must be sacrificed in behalf of those of the profession. It appears to us, however, that this view is mistaken, as we shall endeavor to point out.

In the first place, let it be said that the talk of reforming the Institute is entirely an afterthought in the present movement. If the Institute requires reform, we are quite sure that its management will welcome suggestions; if the management has been remiss in any respect, the members have been more remiss in not attending the meetings and assisting by a manifestation of interest. There is not on record in the archives of the Institute, at least not in recent years, any complaint against its methods or any suggestion for improvement. The argument that a new society ought to be formed because the Institute ought to be reformed, no effort to accomplish the latter having been made, is logically untenable.

In so far as the movement for a new society represents dissatisfaction with the management of the Institute, consequently, the ground does not appear to be well taken. On the other hand the position that the Institute has ceased to be a strictly professional society, having become essentially a publishing society, and that there is need for a strictly professional society, has merit. This has been recognized to a certain extent in the proposed amendment to the constitution of the Institute, introduced at the February meeting, providing for a classification of its members. However, it is doubtful if that could be done so as to meet the conditions for which there is evidently a demand among a considerable portion of the profession. This demand is for the creation of a professional aristocracy. The term is not precise, but it will serve to convey the meaning better, perhaps, than any other single word. If this be the purpose it will inevitably fail if the Institute be disregarded for the following self-evident reason:

Many distinguished members of the profession have already declined to become members of the new society on the ground that it would adversely affect the Institute; others not yet invited, but who are desirable, indeed necessary, have expressed the same opinion; moreover, some who have already joined, considering that the new society would be so planned as not to interfere with the Institute, will doubtless retire if it appears that the reverse is to be the case. Now if the new society fails to include these names it will not be the aristocracy and there will be but slight inducement for anyone to join it. A society comprising all of the great names of the profession, with serious qualifications imposed upon candidates desirous of being enrolled with them, would be something that every professional man would be anxious to join. But otherwise many will ask why they should pay annual dues to a new society, which is not the recognized aristocracy, and will answer in the negative. If numerous distinguished engineers remain outside it will be no reflection upon anyone to be absent from the list of members. What possible object would there be for any of the 200 North American members of the Institution of Mining and Metallurgy, an international or-

ganization in which membership distinctly means something, to join the new society under these circumstances? If the new society include all, or nearly all, of the best in America the conditions would obviously be different.

Consequently it appears that the new society, to become other than a puny thing, must be framed on lines that will overcome objections from many members of the Institute whose coöperation is necessary. Their objections can be overcome only by guaranteeing the continued welfare of the Institute, which means the assurance that no members will be taken away from the Institute. This can be given by making membership in the Institute a prerequisite to membership in the new society; in other words making the latter an organization inside of the Institute. That such a plan is practicable is shown by the Masonic bodies, one inside of another, and also by other precedents. In the present case various understandings would be necessary, respecting the dues of the Institute for example, but no doubt these could be arrived at if the principle were agreed upon. The special dues of the new society ought to be very moderate. It will be argued, perhaps, that some persons desired for the new society are not members of the Institute, but their number must be small. Every mining engineer ought to be a member of the Institute and if any be not already among its members there is no particular difficulty in becoming so.

There is no good reason why the new society should engage in the publication of technical papers. The Institute has fulfilled that function satisfactorily and further multiplication of such literature is unnecessary, undesirable and likely to be burdensome. The discussion of purely professional matters, i.e., matters directly connected with professional practice, the reports of committees appointed to make investigations, etc., will furnish ample material for the publication of a proceedings. It is true that the Institute can discuss such matters, and make investigations and reports, but it is prevented by its constitution from acting upon them and it will be useful to have a society that can express the majority of professional opinion and recommend desirable professional practice. This has been prominently in the minds of those who have fathered the new society. Any useful work in this direction depends, however, just as much upon making the new society comprehensive of practically all of the best names in the profession as does its recognition as an aristocracy.

We think that the above principles, and the way to meet them, will be appreciated upon reflection, and we fear that the expressed sentiment for going ahead with the new society without regard to the Institute comes chiefly from a few who are disgruntled with the latter and have not weighed fully what a split would mean and would lead to. A split in the profession over the matter of technical societies would be contrary to the best interest of all.

The Copper Deposits of Katanga

The article by Mr. Farrell, in this issue of the JOURNAL, will attract general attention, being the first technical description of the marvelous deposits of copper in Africa that have been more or less vaguely discussed during the last five years. When they were first reported, the accounts were so extraordinary and indefinite that few were able to accept them seriously. However, it has gradually developed that they were substantially true as to the occurrence of immense deposits of ore extending over a large area, and it is no longer to be doubted that some day these mines will figure prominently in the copper market, although the present estimates respecting the probable cheapness of their copper are still to be taken with reserve. Obviously there is a great deal of work to be done before the prospects can be accurately determined. At present the chief matter of knowledge is the existence of very large deposits of ore that is of high grade in copper but silicious and entirely oxidized in character.

Mr. Farrell, who is an American engineer of extensive experience, carried on the explorations, of which the results are described in his article, during five years' service as head engineer for Tanganyika Concessions, Ltd. Some wonder may be felt that after so long a time so little is yet known respecting the geological occurrence of the ore deposits and many other details in which professional men are interested. The absence of such information is explained, however, by the reflection that five years in the heart of Africa is still only as one year or less in more accessible countries. After all it is only a few years since the journeys of Livingston and Stanley were admired as wonderful feats of endurance. The engineers exploring in Katanga have had to undergo many of the same hardships, traveling everywhere on foot, with supplies transported by bearers, often in regions dangerous because of pests like the tsetse fly, or strange fatal diseases like the blackwater fever. If an engineer thinks of going on foot a distance like that from New York to Denver, through an unknown, unsettled and extraordinarily difficult country, and then making explorations over an area of many hundred square miles, he will appreciate the inability to go greatly into details. Mr. Farrell's article must be read in the light of this understanding.

Also it will be perceived that he expresses himself conservatively, except with respect to the size and extent of the ore deposits, which apparently are so big as to require big terms. The mines are remote; the ores present certain metallurgical difficulties; so far no workable coal has been found in the country. However, these conditions remind us of Arizona in the early '80s. Of course there are differences. The Southern Pacific railway had already been built across Arizona at that time and the conditions in our West led to more rapid developments than are probable in Africa. On the other hand, capitalists and engineers are now accustomed to consummate gigantic undertakings more rapidly than 25 years ago. Nevertheless, when we consider the many years required to bring the monzonite mines of Ely and Bingham to productiveness we can hardly escape the conclusion that it will be at least 10 years before those of Katanga will figure largely in the market.

However, developments are going steadily ahead. The Cape-to-Cairo railway, which for two or three years, has been stationary at Broken Hill, Rhodesia—only about 225 miles from the Star of the Congo mine—is now, according to a cable despatch of this week, to be immediately pushed ahead to Mabaya on the Congo frontier, and thence to Ruwe in the copper belt. When we consider that for several years lead and zinc ores have been shipped in large quantity from Broken Hill to Europe, the Katanga copper ore does not appear so far away. In the meanwhile, the construction of the Benguella railway is going steaily ahead. At the

end of 1907 about 100 miles had been built and the work was going ahead at the rate of one mile per day. The total distance from Lobito (the Atlantic terminal) to the Lualaba smelting site is 1000 miles, and the line is expected to cost about $30,000,000. About one-half of this has been already financed and it is expected that a temporary line for copper can be completed in about three years.

The Miami Copper Company

A close imitation of the English method of company promotion has just been made by the Miami Copper Company, owning a mine near Globe, Arizona. The mine was secured and prospected by the General Development Company. After proving the existence of a large body of profitable ore, the Miami Copper Company was organized, half of its capital stock being paid to the General Development Company for the property, the other half being reserved to provide for operation of the mine. A portion of this treasury stock has now been offered to the public through the issuance of a prospectus and advertisement of the same in the newspapers.

The advertisement of mining companies in the newspapers has heretofore been considered rather disreputable in this country, chiefly because of the use of this method by disreputable promoters. There is nothing disreputable in such advertising *per se*; the evil has been not in the advertising, but rather in the property advertised. A moment's reflection will show clearly the difference. In the case of the Miami Copper Company, according to the English method, the subscriptions are received by a bank of recognized standing; all of the contracts pertaining to the purchase of the property and statements of the outlay upon it are thrown open to inspection. In brief, the public that is asked to subscribe is accorded full and frank information respecting the enterprise. Obviously this is quite different from the bait offered through newspaper broadsides with which we are familiar.

The question is entirely one of economy in raising money. On the one hand is the customary method of underwriting the stock, creating a market for it in the street, and selling to the public at a large profit. On the other hand, at the comparatively small expense of advertising the transaction is effected directly between the subscribers and the company; the latter may still arrange for an underwriting at a commission to insure obtaining the money it requires. Obviously the public benefits by the elimination of the profit of the middlemen, and moreover has a chance to know something definite respecting what it is buying.

The mining industry will benefit by more of this kind of publicity. The investors will discriminate between the enterprises promoted by well-known operators, and vouched for by engineers of high standing, and those which will not stand the tests. Yet we do not expect to see any general adoption of the method, simply for the reason that it does not offer so many opportunities for "rake-offs" and market manipulation.

The Garretson Furnace

Singular interest is attached to the contribution by the late Oliver S. Garretson, which appears in this issue, from the fact that it was written by him only a week or two before his death. The delay in publication was due to a certain computation in his article which was not clear. Inquiry was made of Mr. Garretson respecting this, but he was already stricken and unable to give any attention to the matter, and correspondence with a gentleman who had assisted him became necessary.

Everyone will regret that Mr. Garretson did not live to see a successful outcome of his idea of smelting and converting copper-sulphide ore in an immediate succession of operations in the same furnace. The idea has been conceded to have merit by such metallurgists as Peters and Bellinger, and theoretically is undoubtedly correct, although there are serious practical difficulties not yet solved. If capable of successful solution there will clearly be great advantage in the process.

The idea engaged Mr. Garretson's mind for 10 years or more, probably to the exclusion of nearly everything else. Various experimental trials have been made, with more or less promise of success, but yet for some reason or other without the clear-cut indication of the accomplishment desired. However, this is the history of many revolutionary inventions, just as in the case of the pyritic smelting process itself. Unfortunately Mr. Garretson became involved in business entanglements respecting his process that took it out of his hands for a number of years.

Shortly before his death he had made arrangements enabling him to go ahead again with experiments on his own account. This he was planning to do, and he was awakened to new enthusiasm by the renewed possession of the ability. It was only a few days before presenting his manuscript that he discussed with us his plans. His sudden demise was regretfully untimely.

The Latest Outrage at Telluride

We were startled recently by the official expression of Judge Fremont Woods, of Idaho, before whom Haywood and Moyer were tried, that in spite of their acquittal and his own favorable charge to the jury, they were nevertheless guilty of the crimes for which they were on trial. Many have been of this opinion; while many others have regarded the verdict as "not proven," rather than as "not guilty." But nearly all have agreed that the Federation leaders had had their lesson and would be good for a long time. It appears, however, that this opinion was mistaken. Since the trial, a brave sheriff in Oregon, who dared to do his duty, has been assassinated in the same way as Steunenberg, and now an attempt has been made to dynamite Gen. Bulkley Wells, at Telluride, in the same house wherein Arthur Collins was foully murdered.

No one who knows the part that General Wells has played in the contest between the mine operators and the Western Federation in Colorado, and particularly his efforts to fix the responsibility for many ghastly crimes upon the Federation leaders, will doubt that the miscreant who planted the bomb under General Wells' bed was a sympathizer with the Federation, if not its direct agent. How long are such things to be?

General Wells has known for a long time that he was a marked man, but his personal courage and unfaltering fearlessness have kept him at his post. It takes nerve and shows bravery of a high order to live calmly in a place where a blow may come in the dark from an unseen assassin at any moment. But this is what he has done. His escape was miraculous and thousands of friends congratulate him. But how long is this band of assassins to go scot-free?

Views, Suggestions and Experiences of Readers

Comments on Questions Arising in Technical Practice or Suggested by Articles in the Journal, and Inquiries for Information

CORRESPONDENCE AND DISCUSSION

Pyritic Smelting and Continuous Converting

Some years ago I took up the investigation of pyritic smelting with the view to its adoption for the treatment of the ores from my own mines in Mexico. An expert was consulted who reported that the ore was ideal for the process, and that a 15- to 20-per cent. matte could be made. Further investigation disclosed the reasons why the process is so self-limited, and made it apparent that the skill of the metallurgist could not carry it beyond its already known limits.

The sulphides melt at a comparatively low temperature before the sulphur can be eliminated and sink to the crucible of the furnace as a low-grade matte. The slag here protects it from further oxidation, thus defeating all efforts of the operator to attain the desired degree of concentration at one operation. When the matte is being resmelted in the pyritic furnace to bring it up to a converter grade, or when the richer ores are smelted and a fairly high grade of matte is made, the slag losses increase rapidly in proportion to the grade of matte produced. We found that if the desired economy in the treatment of low-grade sulphide ores was to be attained, new methods must be devised and apparatus constructed that would permit of the rapid reduction of the ore at one operation, and the production of clean slags on the one hand, and metallic copper on the other.

To attain the desired high degree of concentration it was necessary that the furnace be provided with an ample crucible to catch and retain all the matte made by the furnace, and that the crucible be provided with a set of converting tuyeres through which sufficient air could be blown to convert the matte as fast as it was made, so as to give the operator absolute control over the degree of concentration attained. To complete the process it became necessary to provide means that would also give control over the slag losses. This was accomplished by building a submerged dam across the crucible near the middle of the furnace, dividing the crucible into two compartments. The compartment at the slag end of the furnace always being kept full of low-grade matte, giving the necessary chemical conditions for producing an extremely clean slag. It was thus that the Garretson furnace came into existence and the foundation was laid for what we have called "pyritic converting," that accomplishes the economic extraction of metallic copper and other metals at one operation from low-grade sulphide ores.

The furnace is similar in construction and appearance to the ordinary type of water-jacket furnace. The smelting tuyeres are supplied with a blast of 2 to 2½ lb. pressure to the square inch. The converting tuyeres should be provided with a blast of 8 to 10 lb. pressure.

Advantages of the Pyritic Converting Furnace

The metallurgist operating a pyritic smelting furnace is compelled to carry on all his work in a single compartment, namely, the body or shaft of the furnace above the slag line. In the pyritic converting furnace, however, the operator has three separate and distinct compartments in which to carry on three separate sets of chemical reactions: (1) The body or shaft of the furnace above the slag line in which smelting of the charge is carried on in either a reducing or an oxidizing atmosphere; (2) the converting end of the furnace below the slag line in which oxidizing action is maintained by the air forced in through the tuyeres into the molten matte; (3) the slag end of the furnace which is always kept full of very low-grade matte and melting low-grade sulphide ore through which the foul slag from the converting end of the furnace must pass and be washed and cleaned on its way to the slag spout.

The first step in the Garretson process is the pyritic smelting of the raw ore just as it comes from the mine for the production of low-grade matte and clean slag. In charging the furnace sufficient silica is added in the slag end of the furnace to combine with and satisfy the iron in that part of the furnace oxidized by the smelting blast. In the converting end of the furnace sufficient excess of silica is added to the charge to combine with and satisfy all the remaining iron of the charge.

The second step in the process consists in catching in the crucibles of the furnace all the matte produced, and retaining it there until it is converted by the blast from the converting tuyeres in the converting end of the furnace. The low-grade matte from the slag end of the furnace is made to flow over the submerged dam into the converting end of the furnace as it is needed for conversion to high-grade matte and then to metallic copper.

The third step consists in converting the matte made in all parts of the furnace in the converting end of the furnace under a column of silicious ore. As the silicious residue, called the silicious skeleton by Beardsley, and the quartzose mass by Lang, is gradually being dissolved and slagged off it becomes unable to support the weight of ore resting on it, and it crushes and allows a fresh supply of silica to be forced down into, and in contact with the matte, as it is needed to combine with the oxide of iron there formed.

The fourth step consists solely in blowing blasts of air through the converting tuyeres into and up through the molten matte in the crucible of the converting end of the furnace. As the process of converting proceeds the iron in the matte in the crucible is almost entirely eliminated and the sulphur is so far eliminated that about 20 per cent. of sulphur holds about 80 per cent. of copper in solution.

The fifth step in the process consists in cleaning the foul slag that has been made in the converting end of the furnace. This is accomplished by allowing the foul slag to flow through the slag compartment of the furnace. Here it is washed by a descending shower of low-grade matte from the smelting zone and is compelled to flow over a bed of low-grade matte and through melting and dissolving low-grade sulphide ores.

The sixth and last step in the process consists in tapping the metallic copper carrying the other metals to be recovered from the bottom of the converting crucible from time to time. The blast from the converting tuyeres should always be blown through matte and not the metallic product of converting.

Heat Balance of Pyritic Converting Process

The thermal calculations and heat balance sheets herewith submitted show that pyrrhotite ores of the Sudbury or Ducktown type carry sufficient fuel not only for their own treatment, but also enough to smelt more than 20 per cent. of their weight of a silicious ore that is without fuel elements.

Taking the analysis of green ore as given by Mr. Beardsley, we have: Silica, 10.10; iron, 44.68; alumina, 6.85; lime, 1.19; magnesia, 1.14; sulphur, 27.48; copper, 1.77; nickel, 5.62; total, 100.

It appears at a glance that there is sufficient iron, lime and magnesia to flux the silica and alumina without added lime, provided that the iron can be made available by complete oxidation. It is further apparent that this oxidation, together with the concurrent oxidation of the sulphur, will generate a considerable amount of

heat which may be placed on the credit side in a trial balance sheet.

Taking as a basis of calculation 100 kg. of green ore, with no addition of coke, we have: Iron already oxidized (Beardsley), 7.08 kg.; iron as sulphides, 37.60 kg. Prof. J. W. Richards gives the heat values* for this reaction as follows:

$$\underset{-24}{FeS} + 3O = \underset{+69}{FeO} + \underset{+71\ cal.}{SO_2}$$

This is per atomic weight in kilograms, or 116 cal. excess heat per 56 kg. of iron. We get from oxidizing the iron sulphide, therefore $(116 \times 37.6) \div 56 = 78$ cal. The oxidized iron all slags with silica yielding 19 cal. per atomic weight in kilograms $(19 \times 44.68) \div 56 = 15.16$ cal.

From the same authority we have as the heat generated by burning off the sulphur from copper sulphide:

$$\underset{-20}{Cu_2S} + O_2 = Cu_2 + \underset{+71\ cal.}{SO_2}$$

Thus the available excess heat equals 51 cal. per atomic weight in kilograms, or 1.42 cal.

For the nickel sulphide we have:

$$\underset{-19.4}{NiS} + O_2 = Ni + \underset{+71\ cal.}{SO_2}$$

Thus the available excess heat equals 51.6 cal. per atomic weight in kilograms, or 4.95 cal. The total heat credits are therefore: $78 + 15.16 + 1.42 + 4.95$, or 99.53 cal.

Before computing the losses, it is necessary to decide on a slag composition that will prove easily fusible, and thus determine the amount and nature of the flux it will be necessary to add, and the quantity of slag formed. First disposing of the lime and magnesia, we find from Hofman's slag diagrams that for 52.84 kg. of iron oxide we require 26.42 kg. of silica. Thus the total silica requirement is: $4.11 + 26.42 = 30.53$ kg. The amount present is 10.10 kg., leaving 20.43 kg. silica flux to be added. The weight of slag per 100 kg. of ore thus becomes 97.22 kilograms.

Heat Losses in the Furnace

The quantity of air is assumed by Mr. Wright to have been 2.43 times the weight of the charge, although no explanation is given as to the method by which this figure was arrived at. Taking the method of blast calculation employed by E. D. Peters in other work, it is found that our charge of ore alone requires theoretically: to oxidize the iron, 10.75 kg. oxygen; to oxidize the sulphur, 27.50 kg., or 38.25 kg., equivalent to 166.6 kg. of air. Allowing an excess of 50 per cent., we have 250 kg. of air used per 100 kg. of charge.

To estimate accurately the heat carried out of the furnace by the escaping gases, at 300 deg. C., we must consider each constituent separately: Excess air, 83.4 kg., specific heat 0.2, 5 cal.; nitrogen, 128.35 kg., specific heat 0.244, 9.4 cal.; sulphur dioxide, 55 kg., specific heat 0.1553, 2.6 cal.; total loss in gases, 17 calories.

The loss in the slag, at 1200 deg. C., specific heat, 0.333 will be 38.9 cal.; in copper and nickel, at 1200 deg. C., specific heat 0.0968, 0.86 cal.; and in cooling water in a furnace of the Garretson type which, as tests have shown, smelts at the rate of 14.2 lb., or 6.45 kg. per sq.ft. per minute amounts to 10.2 cal. The only water that can be accounted for in the charge is the 1.17 kg. added to Mr. Beardsley's analysis. This will require for its vaporization 0.7 cal. To decompose the water in the blast will require, adopting Mr. Wright's figure, 7.5 cal. The radiation loss we will also assume to be 10 calories.

LOSSES OF HEAT ACCOUNTED FOR

	Calories.
Escaping gases	17.00
Slag	38.90
Metal	0.86
Cooling water	10.80
Evaporation of moisture	0.70
Decomp. water in blast	7.50
Radiation	10.00
	85.76

The total available heat credits, without added coke were shown to be 99.53 cal. Thus the excess, per 100 kg. of ore, is 13.77 cal., or more than 16 per cent. excess over all requirements and losses.

A furnace 187x34 in. will treat 100,000 kg. of ore in a day of 24 hours (approximately 200 tons), so that the heat excess is 13,770 cal. per day, 574 per hour, or 9.55 per minute, or, in terms of the kg.-cal. usually employed in metallurgical calculations, 9550 calories.)

If the ore does not contain sufficient iron, sulphur, arsenic, etc., to smelt itself, then the deficit can be made up by adding coke or charcoal to the charge, and the smelting proceed without being in any way interfered with by any amount of carbonaceous fuel added to the charge in the shaft of the furnace.

With a properly designed and constructed three-compartment furnace that gives the operator control of the fume losses, the slag losses, and the rate of concentration, low-grade mattes, foul slags and freeze-ups lose their terrors; the metallurgist has become master of the situation.

The thermal calculations for this article have been made by H. G. Bayles, on an ore of the Sudbury type, minor elements being omitted for the sake of simplifying the calculations. I wish to thank Mr. Bayles for the care and time that he has devoted to these figures.

Oliver S. Garretson.

New York, Feb. 24, 1908.

*The calorie used throughout is the metric tonne-calorie, 1000 times greater than the kg-cal usually given in tables of references. Mr. Wright used these same units, applying them without change to pounds, the ratio of credit to debit being unaffected by omitting to divide both sides by a constant factor. These calculations are all made with the slide-rule, and so are not absolute.

The Copper Belt of California

I hope to be allowed space for a word or two by way of final leave-taking of this subject. G. McM. Ross and others have criticized still further my essay on the Copper Belt since the appearance of Mr. Ross' first letter, which misled me into a reply. Mr. Ross now alleges that the publication of my unimportant views as to the downward extent of the orebodies has had the effect of deterring investments in the field, and has already driven away one possible or likely purchaser. I believe that Mr. Ross exaggerates; but for the purpose of clearing up the matter at issue I will venture a few remarks in justification of what I wrote, if it needs justification at all, which only the future can decide.

I am, myself, pecuniarily interested in the Belt since I am the owner of a mine there, by the sale of which I hope to realize a good profit. It may be easily imagined, therefore, that when I say that I believe that the orebodies, or perhaps I should say the average of them, do not go down to more than moderate depths, I speak conscientiously and advisedly. I have permitted myself the luxury of speaking the truth against what would seem to be my own interest; but not, I trust, against the real interests of the owners of the Belt mines, who, in my opinion, will be far more benefited by an open and candid statement of the advantages and disadvantages of their properties than by any amount of absurd and affected puffery and over-acted enthusiasm. There are plenty of able persons who will undertake (for a small consideration) the task of booming a mine, a camp, or a district, and will do it much better than I or Mr. Ross could; and I, for one, prefer to leave the job to them. Any man of decent feelings must feel sympathy for the mineowner who waits and longs for a buyer to appear; but sympathy should not be hemmed in by side lines or end lines; it should extend to those not always fortunate persons who are given to venturing their money in the mines. To this class the engineer, if he has any moral sense, will gradually acquire a feeling of obligation. In writing my essay, which was in a manner a labor of love, I endeavored to deal chiefly with economic conditions, and in a way to reach the understanding, command the attention, and justify the confidence of the average investor. I believe, and doubtless Mr. Ross will agree with me, that it is far more to the purpose to discuss the practical part of mining and ore treatment on the Belt than to pad our writings with scholastic disquisitions, while keeping out of sight any damaging conclusions that we may have reached. For there is hope for the mineowner who recognizes the limitations of his property, but there is none for the wrapt individual who dreams only

of permanent veins and a wealthy purchaser.

My critics appear to find a great deal of fault with my geological deductions, and I dare say they are quite right. I am not a geologist at all, nor do I desire to appear as knowing any more about that fascinating science than just enough to make my mining reports respectable. If, however, the desire arises within my breast to become really expert in that science I promise them that I shall gladly avail myself of the facilities offered by their geological kindergarten.

HERBERT LANG.

Oakland, Cal., March 26, 1908.

[This discussion is now closed.—EDITOR.]

Coal-dust Firing of Reverberatory Furnaces

I have read with great interest the article by Mr. Shelby in the JOURNAL of March 14, and also the comments by Mr. Thomas in the issue of March 28. It seems to me that Mr. Thomas departs somewhat from the point, inasmuch as Mr. Shelby did not state that waste-heat boilers could not be used with coal-dust fired reverberatory furnaces, but that under conditions similar to those existing at Cananea, with the coal containing 18 per cent. ash (sometimes more and never less), their value is as yet questionable, and that it appears that pulverized coal used properly in a well-designed furnace, with suitable equipment, will give a temperature line approaching very nearly a straight line; whereas in the present prevalent practice of attached fire boxes the temperature line is a succession of waves. I think that if a continuous record could also be kept of the duty of a boiler delivering 600 horse-power, it would be found that it might be delivering much more than 600 horse-power immediately after firing, and a correspondingly less amount just previous to firing, indicating that this boiler is in its true sense provided to take care of the waste heat that is generated after firing, and that if the temperature of the furnace were at its proper point just before firing when the boiler would probably not be delivering more than, say, 200 horse-power, the desirability of this boiler would apparently not be as great as at present it is. This, then, implies that the ordinary fire-box reverberatory furnace is always kept up to the proper smelting temperature, and that in order to do this there are times when it must be kept above that point, which occurs, of course, immediately after firing, and as the temperature drops to its minimum permissible point the furnace must be fired up again, producing peaks on the temperature line, which peaks are probably the cause of the greatest amount of waste heat from the furnace.

Now, in the case of the coal-dust fired furnace, it would not be necessary to have these peaks; consequently the amount of available horse-power would be equivalent only to what is actually carried off in the fire-box furnace when the fire is at its lowest permissible stage. Now, introducing in connection with this drop in power recovered the ash difficulties that are bound to occur (especially with such a high-ash coal as is used at Cananea) we find further reasons why these boilers should not be so desirable. Moreover, it is to be considered that the metallurgical operations in a reverberatory furnace making copper matte, and its fusible slag of ferrous and calcic silicates, require a temperature probably only about one-half as high as that used in the puddling furnace to which Mr. Thomas refers. Consequently the gases leaving this long copper-matting reverberatory furnace have no comparison in heat value to those leaving the short puddling furnace, which also, it is reasonable to suppose, is fired with a far superior grade of coal.

After all, this all boils down to the point brought out in the final paragraph of Mr. Shelby's article, viz., that until it has been proved that the problem of smelting at Cananea in the dust-fired furnace has been successfully solved, and incidental to the solution it has been determined what the value of the waste gases are, it does not seem propitious for the metallurgists at Cananea to consider the utilization of the waste heat, whatever it may be. In the absence of the necessary information the policy of wisdom is to be patient and wait, and Mr. Shelby is quite correct in his attitude.

W. B. S.

Philadelphia, Penn., April 19, 1908.

Coal-mine Explosions

Among the leading causes that have been assigned as responsible for the Monongah and other recent explosions, are: (1) runaway trip of loaded cars on an 8-per cent. down grade; (2) blown-out shots; (3) coal dust fired by exploding powder; (4) gross carelessness. While any or all of these causes may be considered contributory, they do not go to the root of the trouble. There are conditions met with in all coal mines where inflammable gases have been distilled from the coal by natural processes, and securely stored until liberated by the cutting machine or the pick. My observations have led to the belief that in a "swamp," or that portion of a coal seam which lies between two parallel rolls, an exceedingly favorable location is found for the storage of gas; this is due to the fact that the bottom or underside of the coal seam, is the long side, and full of small fractures that extend upward into the bed. These small fractures resemble a compressed letter "A" being widest below and diminishing upward, while the top (the short side) of the seam, is closely compressed, which prevents any of the gases from escaping and dispersing into the overlying strata.

Anyone can make a diagram of a segment of a circle which will illustrate how coal seams are more gaseous at some places than they are at others. In driving across a "swamp" these fractures would be cut at right angles, naturally causing a strong flow of gas from the opposite sides. Unusual care should be exercised at such places. Turn the diagram upside down and it will be a fair representation of a roll in a coal seam; in this case the fractures are at the top side of the bed and it is readily evident how various impurities could have silted into the seam. The storage capacity for gas depends upon the depth of "swamp," and the hight, and distance apart of the parallel rolls.

Thick seams afford greater storage capacity for gases than the smaller ones, and a wide deep "swamp" in a coal seam, contains more gas than would be found in a succession of "swamps" and "rolls" at short intervals. This is due to the fact that over the rolls, the fractures are in the top side of the seam, which has allowed the gases to ascend and disperse in the overlying strata.

J. R. HECKMAN.

Johnstown, Penn., Feb. 28, 1908.

Power Cost at Mines

In the article in the JOURNAL of March 14 "Reduction of Working Costs at the Rand Mines" George A. Denny speaks of the distribution of the power cost. In a great many mines the cost of power (steam production) is distributed to different cost accounts such as, hoisting, pumping, compressed air, etc. I believe in every case the distribution is made by guess by the management. Data for making this guess are derived from more or less crude tests, which at best could only show the proper distribution at the time the test was made. The management usually realizes better than anyone else how inaccurate this is, and would like to know a better way of making the distribution. What would be correct one month would be in error the next month as conditions around a mine are constantly changing.

I should like to get the views of some of your readers as to this matter and ask if it would not be advisable to have a cost account "Power" and not try to distribute that which is impossible to distribute correctly.

E. S. DICKINSON.

Florence, Wis., March 14. 1908.

The Brazilian producers of manganese ore expect that the recent addition of 100 freight cars to the equipment of the principal railroad will permit them to export 50 per cent. more ore in 1908 than they did during last year.

Chronology of Mining in March

March 3—Amalgamated Copper Company resumes operations in Montana. Stockholders of the Douglas Copper Company secure control of the Ryall and Mix concessions in Sonora, Mexico. North Butte and Butte Coalition companies in Montana resume operations. Granby Copper Company suspends dividends.

March 4—Calumet & Hecla and Wolverine mining companies reduce dividends.

March 7—Federal troops leave Goldfield and Nevada State police assume responsibility of maintaining order.

March 8—Nine collieries of the Reading Coal and Iron Company are closed for an indefinite period. Government institutes suit against the Anaconda Copper Company to recover $65,000, the value of timber alleged to have been unlawfully cut in Missoula county.

March 12—Iron Mountain drainage tunnel in Montana is completed, the water being successfully and safely tapped.

March 13—Reverberatory furnaces at the Washoe plant, Anaconda, Mont., are started up.

March 14—The blast furnaces at the Washoe smeltery, Montana, begin operations.

March 16—De Beers Mining Company, South Africa, decides to close its Dutoitspan diamond mine.

March 17—Premier Diamond Company refuses to renew agreement with the diamond syndicate for sale of its output.

March 20—Steel men in conference at New York again vote to maintain prices.

March 23—United States Steel Corporation uses its influence to prevent a general strike of coal miners, suggesting that the Pittsburg Coal Company sign the agreement.

March 27—Federal troops are ordered to Douglas Island, Alaska, to protect property threatened by 800 striking miners at the Treadwell mine. Stock of Yukon Gold Company offered to the public.

March 28—Explosion in mine No. 1 of the Union Pacific Coal Company at Hanna, Wyoming, kills 70 miners. Yukon Gold stock floated on curb sells at 8.

March 31—Yukon Gold sells at 5.

Tin Output of Federated Malay States

Consul-General Thornwell Haynes reports from Singapore that the output of tin of the four States of Perak, Selangor, Negri Sembilan, and Pehang, which constitute the Federated Malay States, and produce 60 per cent. of the world's output of tin, was for 1906 and 1907, as follows:

	Tin, Tons.	Tin Ore, Tons.	Total Tons.	Duty Value.
1906	18,259	30,358	48,617	$5,670,791
1907	13,938	34,494	48,432	5,310,646

Exposition of Safety Devices

Lighted lamps that will not explode when turned upside down, containers through which lighted gasolene can be poured without exploding, an industrial chamber of horrors, a model house fireproofed within and without, a mine gallery constructed with steel instead of wood with lagging and gobbed with coal, ambulances and emergency boxes, are among the exhibits to be shown at the exposition of safety devices to open April 13, at the rooms of the American Museum of Safety Devices, 231 West Thirty-ninth street, New York. There is no charge for space; as the object of the exposition is not coercive but suggestive, the inventors and makers are invited to take part by sending their devices to Dr. William H. Tolman, director, at the museum.

Among the exhibitors are the Carnegie Steel Company, Westinghouse Air Brake Company, American Bridge Company, Union Switch and Signal Company, Yale & Towne Manufacturing Company, Travelers' Insurance Company, and others. Three solid gold medals will be awarded for the best devices in transportation, mining, and the best safety device for motor boats and motor vehicles. The chairman of the committee of direction is Charles Kirchhoff, and of the exhibits committee, Prof. E. R. Hutton.

De Beers Consolidated Mines, Ltd.

The nineteenth annual report of the DeBeers Consolidated Mines, Ltd., for the fiscal year ended June 30, 1907, shows receipts, from diamond sales, of £6,452,596, from which was deducted a total expenditure of £3,845,356, leaving a net profit of £2,607,240. After paying dividends of £2,550,000, the balance for the year, including moneys from the previous year's balance, was £932,623.

The output for the year was 9,010,686 loads against 8,144,979 loads the previous year. The amount washed and crushed in each year was 6,626,291 loads and 5,625,592 loads, respectively. The stock of blue ground was increased by 2,622,477, and amounted to 9,391,603 loads at the close of the company's year.

The details of cost and yield are given in the accompanying table.

Development for the year amounted to 167,613 ft. of drifts, tunnels and raises, and 1703 ft. of rock and prospect-shafts.

DETAILS OF COST AND PRODUCTION.

Mine.	Output of Blue Ground for Year.	Yield Per Load.	Value Per Carat.	Value Per Load.	Cost Per Load.		
					Mining. (b)	Washing.	Total.
	Loads. (a)	Carat.					
De Beers	1,525,184	0.37	$15.55	$5.76	$1.21	$0.74	$1.95
Kimberley	578,669				1.71	0.99	2.70
Wesselton	2,104,308	0.32	9.87	3.16	0.86	0.51	1.37
Bultfontein	2,320,538	0.32	10.45	3.31	0.95	0.54	1.49
Dutoitspan	2,481,987	0.24	19.10	4.54	0.97	0.60	1.57

(a) The "load" occupies 16 cu.ft. and weighs about 1600 lb.
(b) Including the cost of handling waste rock.

Regrinding Tailings at the Homestake

Special Correspondence

Regrinding of tailings to insure both higher extraction and increased speed in the work of cyaniding, has been finally adopted by the Homestake Mining Company. The old jig-house is being remodeled, and will be turned into a regrinding plant, where the tailings as they leave the stamps and before reaching the cyanide mills, will be pulverized to a much finer mesh than at present, probably from 60 to 150 mesh.

The Homestake is to use two methods of regrinding and will have its new plant in operation early this summer. The regulation Wheeler pans, seven in number, and a tube mill, are to be operated side by side to learn which will do the better work on Homestake ore. The plant is to have a capacity for the present of about 150 tons of tailings per day and will treat a portion of the tailings, the remainder being reduced at the sand plant. The important feature of the adoption of re-grinding by the Homestake is that, with the exception of the Mogul Mining Company, which is now using an Abbe tube mill with fair success, this is the first attempt at regrinding made in the Black hills, although numerous tests of the Wheeler pans were made at the Homestake before a decision to adopt them was made.

Erratum

In the article "Transportation, Labor and Costs in Central Peru" which appeared in the Journal of March 21 the weight of the locomotives used on the Peruvian Central Railroad is given as 40,000 lb. The correct weight is 40 tons.

Personal

Mining and metallurgical engineers are invited to keep THE ENGINEERING AND MINING JOURNAL informed of their movements and appointments.

Cyrus W. Robinson, of New York, is in Mexico on business.

H. P. Bope, of the Carnegie Steel Company, is in Mexico on business.

T. J. Schweitzer, of Denver, Colo., is examining mining properties in Mexico.

L. T. Durbin and W. G. Boyle, of Denver, Colo., are in western Chihuahua, Mexico.

C. H. d'Autremont, of the Calumet & Arizona Mining Company, is in Mexico on business.

H. Lawrence Read, Kalgoorlie, Western Australia, is making an extended trip through Mexico.

L. S. Judd, of Idaho Springs, Colo., has returned from a trip to Yuma, Ariz., to examine mining property.

R. D. O. Johnson has opened an office as consulting, mining and mechanical engineer, at Phœnix, Arizona.

W. Fischer Wilkinson has opened an office as consulting mining engineer, at 43 Threadneedle street, London.

President J. A. Plummer, of the Dominion Iron and Steel Company, is returning from England to Canada.

F. W. Denton, general manager of the Copper Range Consolidated Company in the Lake Superior district, is in Boston.

William Ewing, of Breckenridge, Colo., has gone to Mexico to take a responsible position with a large placer-mining company.

Leander A. White, manager of the Black Hills & Denver Company, operating at Tolland, Colo., has gone on a visit to Ohio.

J. H. Baker, who represents a large Eastern copper corporation, is now stationed at Madera, California, on the copper belt.

H. W. Kane, manager of the Hearne Gold and Copper Mining Company, at Central City, Colo., has gone to Chicago, Ill., on a business visit.

Robert Schorr, engineer of San Francisco, sailed from New York, April 7, on the steamship "Kaiser Wilhelm der Grosse," on his way to Europe.

W. E. Corey, president of the United States Steel Corporation, is inspecting the properties of the Tennessee Coal, Iron and Railroad Company in Alabama.

Dr. E. R. Buckley, director of the Bureau of Geology and Mines and State geologist of Missouri, has resigned his position, his resignation taking effect May 1.

R. B. Hegardt, local manager of the Old Dominion Copper Company, of Globe, Arizona, has returned to Globe from a brief examination of the California copper belt.

Dr. James Douglas, of New York, has subscribed $10,000 toward an endowment fund for the School of Mining in affiliation with Queens University, Kingston, Ontario.

John Mitchell, late president of the United Mine Workers, has declined a commission offered him by President Roosevelt, to investigate conditions in the Panama Canal zone.

A. Hamilton, of the firm of Hammel & Hamilton, Los Angeles, Cal., is making an extensive examination of the Harris Copper Company's property in the State of Sonora, Mexico.

F. L. Bosqui, metallurgist for the Goldfield Consolidated Mines Company, will remain at Goldfield, Nev., until the completion of the plans for the company's 100-stamp mill and cyanide plant.

Robert S. Botsford has concluded his contract with the Compania General de Minas, of Buenos Aires, Argentina, and has joined the staff of the Poderosa Mining Company, at Collahuasi, Antofogasta, Chile.

Eugene Coste, of Toronto, Ont., well known as an expert in petroleum, is investigating oil possibilities in the eastern part of the State of Chihuahua, Mexico. From Mexico he expects to go to Colombia, South America.

R. C. Shaw, for the past eight years manager of the Montezuma mines in Costa Rica, who was obliged to leave the tropics last January on account of sickness, is now convalescing in Summerville, South Carolina.

G. Becker, vice-president of the Northern Dredging Company, of Chicago, is at Edmonton, Alberta, to superintend the opening of dredging operations on the Saskatchewan river, where the company has a 15-mile concession.

A. N. Clark formerly of *Engineering News*, New York, has been appointed superintendent and chief engineer at the properties of the Arizona-Nevada Gold Mining and Milling Company near Luning, Esmeralda county, Nevada.

Oscar Lachmund has resigned his position with the United States Smelting, Refining and Mining Company at Salt Lake, Utah, to accept the management of the mine, mill and smelter of the Mine La Motte Lead and Smelting Company at Mine La Motte, Missouri.

Carl F. Dietz, consulting engineer of the Cactus Ore Company, Tintic, Utah, has been in Europe on professional business since last November. He intends shortly to go to Norway on mining and milling business and will probably return to the United States next September.

John Hays Hammond, who has been ill at Santa Barbara, Cal., is now improving rapidly and is already in better health than for many years. It is expected that a few weeks will put him on his feet again as a stronger man than since he left South Africa. He is at present at Santa Barbara, but in the course of a few weeks will go to San Francisco, ready to attend to business with renewed health and vigor.

Hugh Rose has resigned as assistant general superintendent of the American Smelters Securities Company to take charge in Mexico as general superintendent of the Guanajuato Development Company and its allied interests, the Pinguico Mines Company, the Peregrina Mining and Milling Company, the Mexican Milling and Transportation Company, etc. Mr. Rose will have headquarters at Guanajuato, State of Guanajuato, Mexico, and an office at 40 Wall street, New York.

A. C. Veatch, of the U. S. Geological Survey, who has been in Australia for the past five months as a special commissioner of President Roosevelt, has just returned to the United States by way of Vancouver, and is now in Cheyenne, Wyoming, where he has been subpoenaed by the Government to testify in the case of the Government vs. the Diamond Coke and Coal Company. Mr. Veatch has made an exhaustive study and analysis of the Australian mining laws and regulations and their operation, and has gathered a large amount of material and information on the subject.

Obituary

Walter S. Davis, who died in Auburn, Cal., April 3, aged 71 years, was born in Milton, Mass., and entered business in Boston. He went to California 30 years ago, and engaged in mining, conducting some extensive placer and hydraulic workings. He made his residence in Auburn for most of that time.

The Duke of Devonshire, who died in Italy last week, was best known by his political activities. He was also one of the largest owners of coal and iron lands in Great Britain and took an active interest in their development. He was for a number of years chairman of the Barrow Hematite Steel Company, Ltd., an important concern.

Societies and Technical Schools

Mining Society of Nova Scotia—The sixteenth annual meeting was held at Halifax March 25 and 27. The following papers were announced for this meeting:

C. J. Coll—Some Recent Explosions in Coal Mines. (President's address.)

F. P. Ronnan—A Practical Suggestion

for Testing the Gold Mines of Nova Scotia.

E. Percy Brown—How Can the Gold-mining Industry of Nova Scotia be Assisted?

W. J. Priske—The West Gore Antimony Mine.

H. E. Coll—Shaft Collar at No. 1 Allan Shaft.

John Johnston—Submarine Coal Mining.

Dr. W. G. Miller, president of the Canadian Mining Institute—Cobalt and its Ores (illustrated by lantern slides and specimens).

A. L. McCallum—The Testing of Nova Scotia Fire Clays.

H. S. Badger—The Mining and Metallurgy of Gold at the Boston-Richardson Mine.

T. J. McKavanagh—Electricity in Mining.

A. A. Hayward—Gasification of Fuel.

J. E. Woodman—The Financial Value of Economic Geological Studies.

E. Percy Brown—Structure of the Ore-body of the Boston-Richardson Mine.

J. Read—Recent Cyanide Practice in Mexico.

J. E. Woodman—The Mapping of Mining Properties.

A. A. Hayward—The Occurrence of Primary and Secondary Brines.

Industrial

The South Chester Tube Company, Chester, Penn., has taken a contract for 50 miles of 8-in. pipe for an oil-pipe line from Texarkana, Tex., to Shreveport, La.

The Moore Filter Company, New York, has just closed a contract with the Golden Crest Mining Company, of Deadwood, S. Dak., for one of its type A plants, having a capacity of 250 tons per day.

The Keystone Driller Company has lately transferred its pump business from Downieville to its main works at Beaver Falls, Penn. The company has just issued an excellent catalog, giving full information about the various types of its Downie deep well pumps, and their operation.

The Westinghouse Electric and Manufacturing Company, through its export department, has received a contract from the Dominion Iron and Steel Company, for a 500-h.p. electric generator, which will be used in the operation of one of the company's iron mines on Bell Island, Newfoundland.

At the annual meeting of the Temple Iron Company, Reading, Penn., recently, the following officers were elected: President, George F. Baer; vice-president, A. F. Law; directors, J. S. Harris, E. B. Thomas, F. D. Underwood, Albert Broden, W. H. Truesdale, Thomas P. Flower, F. C. Smink and W. J. Richards.

The Aluminum Company of America, Pittsburg, recently secured the contract for furnishing the transmission wires to be used in the electrification of the Southern Pacific terminals in San Francisco. Copper is here displaced by aluminum. The contract provides that the conductors for high-tension current shall be bare, and those for low-tension shall be covered with ordinary waterproof insulation.

The Nevada-California Power Company, formerly the Nevada Power, Mining and Milling Company, Goldfield, Nev., is preparing to install a fourth Allis-Chalmers alternating-current generator, of the water-wheel type, having 1500 kw. rated capacity, to augment the enlarged power service, now contracted for in the vicinity, pending the completion of the new hydro-electric stations on Bishop creek, Inyo county, Cal. Current from these generators is transmitted 113 miles at 60,000 volts to Tonopah and Goldfield, Nev., with branches to other points.

The United States Metal Recovery Company has begun active work upon the construction of a plant at Frisco, near Ellwood City, Penn., for the treatment of rare metals, such as tungsten, vanadium, uranium, etc., for use among the steel industries. The plant will consist of the main building 85x150 ft., laboratories covering an area of 50x100 ft., power-house 50x50 ft., and office building 40x75 ft. The buildings will be of concrete construction. The work is now being advanced on the smaller buildings of the plant. The processes of manufacture which the company will use are protected by patent, and it is expected that research work in an advanced manner not before attempted in this country, will be carried on. The officers of the company are as follows: President, Robert McKnight; vice-president, Jean De Backer; secretary and treasurer, Walter S. Butler, Pittsburg. The company's offices are in the People's Bank building, Pittsburg.

Trade Catalogs

Receipt is acknowledged of the following trade catalogs and circulars:

Julius Bordollo, Kingsbridge, New York City. Peat Machinery. Pp. 16, illustrated; paper, 9x11 in.

Beaudry & Company, Inc., Boston, Mass. The Champion Power Hammer. Pp. 14, illustrated; paper, 3½x6¼ in.

Safety Emery Wheel Company, Springfield, Ohio. Emery Wheels and Grinding Machinery. Pp. 186, indexed, illustrated; paper, 6x9 in.

Crosby Steam Gage and Valve Company, Boston, Mass. Pressure Testing Apparatus. Pp. 16, illustrated, paper, 4x8¼ in.; 1908.

Vulcan Iron Works, Wilkes-Barre, Penn. Vulcan Self-Contained Electric and Steam Hoists. Folders, illustrated, paper, 6x9¼ in.; 1908.

Keystone Driller Company, Beaver Falls, Penn. Catalog No. 6. Downie Deep Well Pumps. Pp. 62, illustrated; paper, 8¼x11¼ in.; 1908.

Western Electric Company, Chicago, Ill. Bulletin No. 5910-3. Power Equipment for Cement Mills. Pp. 24, illustrated, paper, 8x11 in.; January, 1908.

Sterling Emery Wheel Manufacturing Company, Tiffin, Ohio. Emery Wheels, Grinding and Polishing Machinery. Pp. 93, illustrated; paper, 6x9 in.; 1908.

Ingersoll-Sergeant of Canada, Ltd., Montreal, Canada. Catalog No. 1. Ingersoll-Sergeant Rock Drills and Mountings. Pp. 30, illustrated; paper, 6x9 in.; 1907.

Star Corundum Wheel Company, Ltd., Detroit, Mich. Catalog No. 8. Emery and Corundum Wheels, Grinding Machinery and Sharpening Devices. Pp. 102, indexed, illustrated; paper, 6x9 in.

Hendryx Cyanide Machinery Company, Denver, Colo. Catalog No. 5. Apparatus for Cyaniding of Gold and Silver Ores and the Treatment of Copper Ores. Pp. 20, illustrated, paper, 5½x8½ in.; 1908.

Construction News

Isaac's Harbor, Nova Scotia—The Boston-Richardson Gold Mining Company is preparing plans for increasing its mill from 60 to 120 stamps. Goldboro, N. S., is the company's local address.

Rathbone, Colo.—The new Pennsylvania Mines Company will install a 20-drill air compressor, and is preparing to put in a 250-ton concentrating mill. W. H. Leewald, Rathbone, Colo., is manager.

Central City, Colo.—The Chicago-Carr Mining Company will install electrical machinery to take the place of hoist and other machinery destroyed by fire. Bruce M. Meyers, Central City, Colo., is manager.

Buchanan, Virginia—The Virginia Iron, Coal and Coke Company will install machinery for quarrying, crushing and washing limestone. John B. Newton, Bristol, Va., is vice-president and general manager.

Hahn's Peak, Colo.—The Hahn's Peak Gold Mining and Milling Company is figuring on the erection of a 100-ton milling plant on its property. Hahn's Peak, Routt county, Colo., is the company's address.

Shreveport, La.—The Caddo Gas and Oil Company is preparing to build a pipeline 57 miles long, from the Caddo oilfield, near Shreveport, to Texarkana. S. S. Hunter, Shreveport, La., is president; J. C. Markley, New York Life building, Chicago, is engineer.

Special Correspondence from Mining Centers

News of the Industry Reported by Special Representatives at Salt Lake City, San Francisco, Toronto and London

REVIEWS OF IMPORTANT EVENTS

San Francisco

April 2—After a shut-down of two years, a part of the smelting plant of the Bully Hill Mining Company, at Winthrop, Shasta county, was started up March 30. A large sum has been spent in improving and increasing the capacity of the plant. There are now two blast furnaces, each with a daily capacity of 500 tons and a reverberatory furnace of 80 tons capacity. Between 400 and 500 men will be employed. The smelter men will work 8-hour shifts instead of 12 hours as they did when the plant closed down. There are already more men at the camp than can be given work. The Sacramento Valley & Eastern Railway will shortly begin to operate trains on a regular schedule to Pitt, on the Southern Pacific main line.

The Oakland Stock and Bond Exchange has suspended business, with the understanding, however, that it may start up again when financial matters are in better shape. The Exchange found that most of this business is done in San Francisco.

Reno, Nevada, has started a stock exchange for mining men and investors of Reno and Rawhide districts, as well as for other mining districts of Nevada. The idea is to make Reno the mining center of Nevada, if possible.

The R. B. Finley black-sand concentrator, which has been operating at Cherokee, Butte county, has completed a season's run and will ship the black sand to the Selby smelter for reduction.

The United States Diamond Mining Company, of Cherokee, Butte county, has been boring its property with drills to prove the existence of a "pipe of Kimberlite," and has quit drilling, being satisfied with results. A three-compartment shaft is being sunk, and two 50-ft. shafts have been started. Meantime, published reports are to the effect that a few small diamonds have been found, and a temporary washing apparatus will be built, by which the ground may be tested.

It may be stated that a mass meeting of farmers of Valley, near Martinez, Contra Costa county, was held recently and $40,000 was pledged to fight the smelters at Selby and Bulls Head Point, and an endeavor was made to get the supervisors of the county to adopt the same ordinance as that in force in San Mateo county. The supervisors appointed, at their request, a committee of three to consider the subject. It is to consist of a farmer, a smelter representative, and a third man chosen by these two.

An agreement has been reached between the miners and the mine owners of the Melones Mining Company, Calaveras county, whereby the strike that has been in progress there between the Western Federation of Miners and the mine operators has been settled. The men struck for eight hours a day, the question of wages not being considered. After several months the agreement was reached, the men getting the hours they asked for. Work has been resumed.

The county officials of Fresno county have been viewing certain sections with the object of building roads to certain mining districts like Eagle Peak, Trimmer Springs, etc. On the sides of Eagle Peak a new district has been located and there is now considerable activity. It is thought that the Sycamore creek placers, at the base of the Peak, derived their gold from the ledges on the mountain. The proposed road to the district will cost $6000 to $8000.

Salt Lake City

April 5—Judge Marshall in the Federal Court has suspended the injunction against the United States lead smelter, which means that it will be opened again. As the company will immediately begin the construction of the new converter-roaster plant and the installation of other devices for the purpose of controlling the fumes, it will probably be 60 days before any furnaces are started. About 800 men will be put at work at once. The United States Smelting, Refining and Mining Company, according to the decision of Judge Marshall, is permitted to treat a tonnage of ore, carrying 25 per cent. sulphur, amounting to one-third of its capacity. It must remove all solid emanations that issue from its roasters and blast furnaces. Among these emanations are those compounds of lead, copper, arsenic and antimony which appear in an impalpable form, and which, according to the testimony before the court, are the substances which have done the damage in the past. The company must remove all traces of sulphur trioxide or sulphuric-acid gas. The maximum amount of sulphur dioxide or sulphurous-acid gas which may issue from the smokestack of the company is placed at 0.75 per cent. All fumes issuing in any part of the smelting process must be collected and sent through a single smokestack. Only lead ores can be treated by the company. The copper section of the plant still stands idle. The United States company asked for a modification of the original decree. A suspension of the injunction resultant from that decree was granted. The original decree still stands in the form written by Judge Marshall when the case was passed upon two years ago.

The Tintic Smelting Company is pushing work on the construction of its new lead and copper smelter in the Tintic district. The company has met with such popular favor with producers that the original plans have been materially changed, and the plant is to be larger than was originally intended. Nearly all the Tintic mining companies which depend on the custom smelters to get their ores treated have contracted their output to the new competitor of the American Smelting and Refining Company. An effort is being made to induce the railroads to grant common-point rates on ores shipped from outside camps to the Tintic plant. Park City and Pioche producers are desirous of sending their ores there for treatment.

Butte

April 8—During March the mines of the Butte district yielded 584,750 tons of ore from which there has been an estimated production of 18,125,000 lb. of copper. Some of the mines, since their resumption of operations on March 1, have reached their normal production, while others are still restricted in their output. The Washoe smelter at Anaconda began to turn out metal March 18. The North Butte company during the latter part of the month mined from 1200 to 1350 tons of ore daily. The Butte Coalition company is mining only in the Rarus, and its ore averaged about 6 per cent. copper for 11 days. When mining is resumed in the Minnie Healy, the Tramway and Snohomish, this company will be able to mine no less than 3000 tons of ore per day.

Judge Hunt, of the Federal Court, has given the first decision in a number of suits pending in controversies between quartz and placer locations in the southern part of the city; the decision favors the placer titles.

Denver

April 4—The suit of Helen Van Cise and others against the Ibex Mining Company, of Leadville, which has been pending for six years, and involved the sum of

$8,000,000, has been decided in favor of the company by Judge Lewis, of the Federal Court, who ruled that the plaintiffs had lost their title through failure to pay assessments. He also decided that advertisement in a newspaper, notifying a delinquent coöwner that unless he paid his share of the assessment work, his title was lost, was a legal basis for forfeiture; and further, that a United States patent is not proof of the ownership of a mining claim, but simply a certificate showing that there are no conflicting claims, and that questions of ownership must be decided by the courts, and not by the Department of the Interior. An appeal will be taken.

At Cañon City, the plant of the United States Smelting and Refining Company has resumed operations after having been closed down for three months. The Empire zinc works have also started up again.

Indianapolis

April 6—At midnight, March 31, expired the mining contracts in all of the soft coalfields, and only in the Indiana block coalfield and in the central Pennsylvania field have new contracts been signed up between the miners and operators. In the Indiana bituminous field an agreement was reached at the Terre Haute meeting that the miners should continue to work until a new contract is entered into, and the indications are that a new contract will be made within a short time.

One of the first official acts of President Lewis was to invite the operators in Indiana, Ohio, Pennsylvania and Illinois to meet the representatives of the miners in a conference with a view of reinstating the joint relations between operators and miners. The operators responded favorably and the meeting will be held in this city today. If satisfactory results grow out of this conference President Lewis will at once convene the new national executive board.

The feeling on both sides is that a settlement will be reached. The miners are particularly worried over the situation because this suspension being neither a strike nor a lockout they cannot draw benefits from the national organization.

President Lewis is a strong advocate of the re-adoption of the old Interstate Agreement, and this plan has supporters among many operators as well as all the miners. It is beginning to look as if the operators, while willing to enter into an agreement for a joint conference, were determined not to have the Interstate Agreement reëstablished while Mitchell was president. The object of the new conference will be to issue a call for an Interstate joint convention, and, if necessary, to agree on a general resumption of mining operations pending its meeting. The Interstate joint convention of the Southwest, which separated last week, has been brought together again and meets at Kansas City, April 6, to negotiate a wage scale.

The miners and operators composing district No. 11, held a meeting in Terre Haute during the past week, but made little progress toward the adoption of a new joint contract. The matter has been turned over to a committee. Both miners and operators prefer to respond to the call of President Lewis for a joint conference of the central competitive field which they felt was sure to grow out of the Indianapolis meeting.

Toronto

April 4—Difficulties have arisen between the Dominion Iron and Steel Company and the Nova Scotia Steel and Coal Company about the title to extensive submarine iron-ore deposits at Wabana, Newfoundland. The Dominion Steel Company, which owns a large area, lays claim to a part of the holdings of the Nova Scotia company. Another complication between the companies concerns the submarine coal deposits at Point Aconi, Nova Scotia, where the Nova Scotia and Dominion coal companies are both operating. J. T. Burchell, who holds a submarine lease, has brought action in a Nova Scotia court to prevent certain operations of the Dominion Coal Company which he claims to be prejudicial to his interests. Should he be successful the plaintiff has a similar case against the Nova Scotia company. The Dominion Steel Company holds an option on Burchell's leases, and these proceedings are supposed to be taken with a view to forcing the Nova Scotia company into an amalgamation with the Dominion Steel Company.

Considerable uneasiness is felt in mining circles here concerning the prospect of renewed labor troubles in Cobalt. Last year's strike has never been officially declared off by the miners' union, although union men were temporarily permitted to work during the winter. The officers of the union now state that after April 18, union men will be called out from all mines where union conditions do not prevail.

New maps of the James township silver area, just issued, show approximately 400 native silver discoveries. This is regarded as a better showing than that made by Cobalt at the same stage of development. In the southeast corner of the township the Lucky Godfrey syndicate has six claims, on one of which is a vein, 6 to 8 in. wide, of smaltite and nickelite carrying native silver. Arrangements are being made to develop the property and to sack the ore from the surface.

Great activity prevails in the mining district of Port Arthur, where 68 claims were recorded within a week, nearly all on gold and iron locations. A large deposit of rich hematite ore has been found on the route of the Canadian Pacific Railway, 100 miles west of Port Arthur. Several test pits have been sunk over an area of 640 acres and ore assaying as high as 64 per cent. iron has been found.

London

March 26—The Institution of Mining and Metallurgy holds its annual general meeting this month. The principal awards fall to Sir Archibald Geikie, in recognition of his eminent services to geological science, and to Dr. Kirke Rose, in recognition of his researches in the metallurgy of gold and of his contributions to the literature of the subject. The Institution continues to be active in promoting educational work, especially in making arrangements with many of the leading mines all over the world for post-graduate courses for the best students of the year of the Royal School of Mines and of other mining schools. These post-graduate courses are practically scholarships of the value of about £120, because a feature of the scheme is that the students are paid by the mines a sum calculated to cover their living expenses. During the past year 17 students have been placed on mines in South Africa, India, Australia, Colorado and Mexico. The council receives most gratifying letters from the students, who appreciate fully the advantages of these courses, which bring them in touch with the best professional practice and which in most cases lead to employment at the termination of the course.

The Institution further encourages education by awarding annually out of its own funds five scholarships of the value of £50 each for post-graduate work. The young mining student, who is fortunate enough to be selected for a post-graduate scholarship has facilities given him for rising in his profession which in former days were to be obtained either by influence or luck.

The Mysore gold mine of India paid a dividend of 135 per cent. for the year 1907. The total yield was 210,910 oz. standard gold or 193,333 oz. fine gold. The authorities would oblige statisticians if they would fall in line with the rest of the world and report in fine ounces instead of standard. The tonnage milled was 194,838 tons so that the recovery was close on 1 oz. to the ton. The ore reserves were stated to be over 900,000 tons or a sufficient supply for 4½ years' crushing. An important change in the policy of the company is announced. It is intended to provide in the future for fresh capital expenditure that may be needed to be paid out of revenue and not by the issue of new shares. John Taylor & Sons, the managers, gave an encouraging report about the condition of the mine the development of which is showing up very well indeed.

Mining News from All Parts of the World

New Enterprises, Installations of New Machinery, Development of Mines and Transfers of Property Reported by Special Correspondents

THE CURRENT HISTORY OF MINING

Alabama

Alabama Consolidated Coal and Iron Company—This company's statement for 1907 shows gross earnings $2,585,542; miscellaneous income, $118,365; total, $2,703,907. Operating expenses were $1,948,506; interest, depreciation, etc., $396,523; total, $2,345,029, leaving a surplus of $358,878. From this dividends on preferred stock amounting to $87,000 were paid, leaving a net surplus of $271,878. The company proposes to make an issue of $5,000,000 bonds to refund the existing bonds and provide for future improvements and additions to property.

Alaska

The San Francisco Chamber of Commerce has arranged for a regular steamship service from that city to points on the Alaskan coast, so as to try and revive the trade with the growing Alaska mining districts, which the city once had, but which has gone to Seattle, Washington. Meantime the steamship companies operating vessels from Seattle and Tacoma to Nome and other northern ports are arranging for the northern trade, which begins in June. Quite a number of steamers are scheduled for the Alaska run. It is expected that more miners will go north this year than has been the case for several seasons past. The heavy output of Fairbanks, of Tanana district, and the new discoveries at Susitna and the Koyukuk, have revived interest in Alaska. The Nome region will take its regular summer population from the outside and the newer camps will have large accessions of prospectors and miners. The news from the Koyokuk is encouraging. The river is a long one, tributary to the Yukon, and reaching far toward the north. It has been more or less prospected for years, but nothing of note has been discovered until lately. On Nolan creek high-grade ground has been found. In the Valdez section some high pans are reported also

Arizona

Graham County

New England & Clifton Copper Company—This company has been formed by consolidating the New England Copper Company and the Clifton Consolidated Mining Company. Ore is being shipped to the Shannon smelting works.

Pima County

Mansfield Mining and Smelting Company—This company, which has its headquarters at Kansas City, Mo., has placed with the John A. Traylor Machinery Company, Denver, Colo., an order for a smelter. The order includes the design, construction, furnishing of the entire equipment and the operation of the smelter for a given period. The smelter is to be erected at the company's property near Patagonia.

Santa Cruz County

Mineral Hill Copper Company—This company has contracted with the John A. Traylor Engineering Company, Denver, Colo., for a 100-ton concentrating plant, to be erected at its mines near Tucson.

Yavapai County

Sycamore—The company has closed down because of inability to handle a heavy flow of water which has been struck. Prospecting will be continued by means of diamond drills.

Yavapai Oil and Development Company—This company has been drilling for oil, near Valley, 30 miles north of Prescott, for the past eight months. On March 24 news was circulated that a strike of oil had been made. A large number of prospectors rushed to the ground and the country is now staked for miles in every direction. The country rock is limestone which has a very slight inclination from the horizontal. The supposed oil lands lie along a small valley and on the adjoining foothills. There are no surface showings which would indicate that oil would be found. The company has one well down a depth of 845 ft. The well at this time produces a little water, which has a slight scum on it, said to be oil, but which to others presents a greater resemblance to slimed mica. It is alleged that the bottom of the well is in sandstone, but a careful examination of the drillings and fragments taken from the well reveal the fact that the supposed sandstone is composed of quartz, feldspar and mica with a little hornblende. The drillers are making only about 3 ft. per day, for the so-called sandstone is very hard. A number of mining men who have visited the fields express grave doubts as to the probability of finding oil in the formation now being prospected.

California

Amador County

Fremont Consolidated Mining Company—This company has started up 25 stamps of the mill at Drytown, which will be kept running until shaft repairs are finished, when the whole number of stamps will be set at work.

Little Amador—A new plant for this mine has been ordered, and Samuel Pearce has been placed in charge of the property.

Butte County

Cape Horn—It is expected that the new incline will shortly reach the gravel, when a cross drift will be made to determine its extent.

Lovena—Bowers & Dresser have found a 4-ft. ledge carrying high values in this mine near Enterprise.

Sunset Mining Company—This company near Oroville, which formerly operated the Old Glory mine, has raised a fund to reopen and develop it. It was through misrepresentations concerning this mine that G. W. Rumble was convicted and sent to the State prison for a short time.

Calaveras County

Crystal—This property at Angels has been closed down, pending the building of a 20-stamp mill.

Eldorado County

Green Valley Mining Company—This company, working a gravel channel on the Dormody ranch, is using a hydraulic elevator operated by a gasolene engine. The engine pumps the water under pressure, so the gravel is raised in the elevator from 8 to 15 ft., and then emptied into sluices where it is washed for the gold.

Inyo County

Shafer, Thomas & Dickman have located 16 mining claims about 4½ miles southeast of Keeler, and have discovered good ore. A number of leases have been granted and are being worked. Gold is found in the croppings. The new camp is near old Cerro Gordo hill.

Mariposa County

The Pearson claim on the Merced river, near Nameless dam, half a mile from the Yosemite Valley Railroad, is yielding some rich ore, and numbers of prospectors have gone to the vicinity.

Nevada County

Idaho-Maryland—At this old property, Grass Valley, 20 stamps are now being

run on ore. The rich pay-shoot continues. The old shaft is to be re-timbered to the 1000 level and a new 1000-ft. vertical shaft sunk. Bray Wilkins is manager.

Cold Spring — Superintendent Thomas Coan has received word that work is to be resumed on this property shortly. The gravel found last year was believed to be from the Harmony channel.

Midas Mining Company—A contract has been let for a headframe with self-dumping skips, ore-bins, etc., for this mine, and a steam pump will be installed.

Native Son—This mine in Blue Tent district is being reopened, by Wm. Bishop and others, who have taken a bond upon it. This used to be known as the Home mine.

Posey Cañon Gravel Mining Company—In this mine a fine body of pay gravel has been found in driving the tunnel. The company has been 35 months driving the tunnel to encounter this gravel channel which is supposed to be the old Blue Lead on Alta Hill, which was lost many years ago.

Placer County

Home Ticket—R. L. Fletcher has bought this gravel mine at Last Chance from Alfred Dixon and Mrs. Tillotson for a reported price of $100,000.

San Bernardino County

Arrastra Cañon—Joseph Wheeler has found a ledge of gold-bearing ore in this cañon above Victorville, and this has attracted numerous prospectors who are staking out claims.

Jumbo—Chas. A. Hopkins has purchased the Jumbo claims at Hart from Foster & McClurky, and 40 men will at once be set at work. A wide ore-shoot has been proved up, with ore averaging $39 per ton. The town is three miles from the Searchlight branch of the Santa Fe Railroad. Some high-grade ore has recently been found in the Big Chief mine. Water has been piped into the town from a distance of 25 miles.

San Diego County

Dulzura—A good many people continue to go into this new district notwithstanding discouraging reports sent out by those earlier on the ground. A number of sales of properties have been made, and some discoveries of free gold ore are reported several miles from the first locations. A limited amount of work has thus far been done on the claims.

Mercy—At this quicksilver mine in Little Panoche a body of good ore is being developed, and a new furnace with oil as fuel is to be put up.

San Luis Obispo County

Klau—It is reported that the owners of this quicksilver mine are about to sell to a new company, which will sink a new shaft and develop the mine more thoroughly. The machinery has been put in good working condition.

Shasta County

Delta Consolidated—This company is about to build a short railroad to connect the mine with the main line of the Southern Pacific at Delta, where ore-bunkers will be erected.

Bully Hill—The smelter of this company at Delamar started up March 30, after a shut-down of two years, during which time the plant has been enlarged and improved.

Siskiyou County

Elk Creek—At this place, 15 miles southeast of Happy camp, a new quartz-mining section is being opened. Business men of Weed are opening up the properties of the Elk Creek Mining Company. In the claims of J. H. Malone a wide vein carrying copper and gold, has been discovered. The Ely claim adjoining carries also a wide vein.

Trinity County

Bonanza King — Arrangements have been made to clear off the indebtedness of this mine, and Supt. J. H. Porter expects to start the mill and put 50 men at work by April.

Tulare County

Deer Creek—Ore from this mine at White River, recently milled, ran high enough to warrant the company arranging to install a mill and work the mine steadily.

Tuolumne County

Black Oak—This noted property in the East Mother Lode belt near Soulsbyville, has been sold by the Scotts, Campbells and Dowe for $202,000 to S. A. Knapp on three years' time. The property involved comprises the Black Oak, Live Oak, White Oak and Carra quartz mines, the Black Oak and Live Oak mill sites, a 40-stamp mill, hoisting works, cyanide plant, residence, office and assay buildings, blacksmith shop, tools, machinery, pipe lines, ditches, roadways, etc. The mine was, for many years, a large producer.

Yuba County

Bessie—A Grass Valley company which has this property at Brown's Valley under bond is preparing to erect a mill. Byron Burgess is superintendent. The mine has a good hoisting and pumping plant.

Indian Hill—This mine, near Camptonville, has been granted a permit to mine by hydraulic process, and a large restraining dam to hold tailings is being built.

Colorado

Clear Creek County

American Gold Standard — Arrangements are being made for the installation of an air-compressor plant for working the Black Eagle mine on Chicago mountain, near Idaho Springs.

Lamartine — John Lang, of Idaho Springs, has taken a lease on this mine; it will be worked in blocks under subleases.

Magnet—This company has taken a lease and bond for $60,000 on the Magnet property and the first carload of ore netted high in gold, silver, lead and copper. The mine is at Georgetown.

Red Oak—St. Louis, Mo., people have become interested in this property and the management is to be in the hands of C. H. Poirer, of Georgetown.

Custer County

Geyser—Progress is being made in the unwatering of this mine at Silver Cliff. The pump at the 1200-ft. station has been started, and the workings at the 1400-ft. level are uncovered and found in good condition. Two shifts are employed.

Dolores County

United Rico Mines Company—This company has made an important strike of lead-zinc ore in the Shamrock claim at Rico. The orebody is said to have been opened for 210 ft. in length and about 20 ft. in width.

Las Animas County

H. W. Anderson, of Denver, has leased a tract of coal land at Toller, and has a force of 75 men at work opening up a mine.

Ouray County

Black Bird—The new owners of this property have begun work, and it is understood that their plans include the installation of a power plant immediately and the building of a mill later in the season.

Snow Flake—This mine, at Red Mountain, is being worked by C. E. King under bond and lease, and is showing up well.

Park County

California—These claims, at Alma, have been sold by H. J. Morgan to George W. Logan, who is arranging to start work soon.

Pitkin County

Chicago Development Company—This company is collecting material and engaging men in preparation for the reopening of its Richmond Hill mine.

Smuggler-Durant—Work was resumed in these mines at Aspen on April 2, about 400 men being employed. Elias Cohn is manager.

ROUTT COUNTY

Hahn's Peak Gold Mining Company—This company, operating the Royal Flush mine near Hahn's Peak, is figuring on the erection of a 100-ton milling plant during the coming summer.

SAN JUAN COUNTY

Kittimac—Ground has been broken for the new mill for this mine at Silverton. It will be at the mouth of Minnie gulch, and will be connected with the mine by a wire-rope tramway about 10,000 ft. long, for which the towers are already in place and the cable ready. The mill will have a capacity of 100 tons per day.

SAN MIGUEL COUNTY

Calumet-Telluride—This company has been pushing development work on its group of claims in Chapman gulch, near Ophir, and has opened up a considerable orebody, running well in lead. It is proposed to put in a concentrating plant.

Little Mary—About 25 men are at work in this mine on the north side of Marshall basin. The ore is shipped to the Pandora mill at Telluride.

SUMMIT COUNTY

International—This company, at Robinson, has decided to build a smelter, using a new process said to have been successfully tested at Boston. H. M. Shepard, Robinson, Colo., is manager.

Little Sallie Barber—It is reported that the American Zinc, Lead and Smelting Company has acquired this property for $20,000. It is in the Breckenridge district.

Mekka French Gulch Placer—L. C. Lennox, of Colorado Springs, has acquired this property at sheriff's sale, and it is reported that it will be transferred to the Lincoln Gold Mines Company and actively worked.

New Pennsylvania Mines Company—It is reported that this company, at Rathbone, will commence the work of erecting a 250-ton milling plant, to be operated by electricity. The company also proposes to install an air compressor to drive 20 drills. W. B. Leewald is manager..

TELLER COUNTY—CRIPPLE CREEK

Shipments of ore from Cripple Creek in March were 61,062 tons. This shows the effect of the lower treatment charges. The total includes a lot of low-grade ore and dump material.

Anchoria-Leland—This mine, leased by Carey & Roberts, is again shipping. A good vein has been opened on the fourth level.

Granite—This mine shipped 114 carloads of ore in March, most of it from the ninth and tenth levels.

Rexall—This company, at Victor, has its shaft down 700 ft., and is going 300 ft. deeper. Several promising veins have been cut recently.

El Paso Consolidated—The report, just issued, shows a surplus of nearly $500,000. It is reported that two parties of lessees are in pay ore, and it is expected that one or two dividends from royalties will be paid this year.

Portland—A cave in a stope of this mine has disclosed a body of ore said to be 110 ft. in width, and to average $30 per ton.

Stratton Estate—The leases, about 40 in number, expiring April 1, have been renewed for one year on the same terms as before.

Idaho

BLAINE COUNTY

Black Barb—This old mine in Kelly gulch, near Hailey, is to be reopened. It is owned by Frank Black.

Boston-Idaho — This company has bought from J. B. Frank, of Denver, Colo., the Lucky Boy group on Boyle mountain, adjoining its own property. The mine carries zinc-lead-silver ore. Plans are being prepared for a new mill, to have a capacity of 100 tons per day.

Dacherl—In this claim in Panther gulch, nine miles northwest of Hailey, it is reported that cinnabar has been found in the adit, which is now in 720 ft. The vein is said to be 4 ft. wide where struck, and has been opened for 20 ft. in length.

Indiana

LAWRENCE COUNTY

A tract of land in Spice Valley township, southeast of Bedford, said to contain large deposits of iron ore, has been sold to the Ohio Iron Company. The new company will develop the land and build a railroad to the Baltimore & Ohio at Huron.

PIKE COUNTY

Only a portion of the coal miners are working in the mines because all the side tracks along the Southern Railway are lined with loaded flats. The winter's force is still employed, but many miners are searching for employment elsewhere. The sale of coal is dull, but the local mines will store considerable coal as a precaution. There is little likelihood of a strike, since both the operators and miners are satisfied with the present scale of wages. Many of the mines in this county are new ones, and are working under leased land, and the operators are anxious to run this summer to get out as much coal as possible before the leases expire.

Old Winslow Gas and Coal Company—This company, which went into the hands of a receiver three years ago with over $100,000 liabilities and $60,000 assets, has been reorganized by St. Louis and local capitalists under the name of the Cedar Creek Gas and Coal Company, with $150,000 capital stock. The old company owned a number of mines and nearly 1000 acres of coal land and many tenement houses in and near Winslow. Besides these the new company will buy and lease new territory and will sink several new shafts along the Southern railway.

VIGO COUNTY

The coal operators of this district have taken steps toward relief from damage claims against them because of the sinking of surface land over coal mines. This has become a very serious matter since the Indiana Supreme Court has decided against the operators. Coal-land leases require the operator to strip the coal as closely as possible, the land-owner demanding all the royalty he can get.

Throughout this field there are many instances of subsidence of the surface. Frequently the land has been sold by the original owner, and the decision of the court is that though the new owner purchased it after there had been a subsidence, he can recover because of any farther sinking of the surface. In some sections damage done is great and in others disaster is apprehended. In one instance a schoolhouse had to be abandoned.

Michigan

COPPER

King Phillip—Under the management of the St. Mary's Mineral Land Company this property is being opened up systematically. No. 1 shaft is down to the 8th level and a plat is being cut preparatory to crosscutting to the lode. At the 7th level the lode was reached 160 ft. from the shaft and found to be well mineralized. An electric hoisting plant is to be installed at this shaft and part of the apparatus is on the ground. Current will be obtained from the Winona power plant. No. 2 shaft, situated on the south side of the Sleeping river and about 2800 ft. south of No. 1, is down 240 ft. and a crosscut will soon be started to cut the lode. With the completion of the hoisting plant at No. 1 shaft the company's surface equipment will be ample to take care of its requirements for some time to come.

Quincy—Preparations are being made to equip all the single heads at the stamp mill with 24x25-in. cylinders. One head, equipped with a cylinder of this size, has done continuous service for more than nine months, and has treated on an average more than 700 tons of rock per 24 hours with a loss of less than 2 per cent. in running time. These heads will operate on 100-lb. steam pressure, and with roll equipment to take care of the oversize an average of 800 tons daily can be handled.

Copper Range—The shaft on the Globe tract is down nearly 800 ft. It is figured from diamond-drill data that the lode will be encountered at a depth of from 850 to 900 ft. As the shaft is going down pre-

parations are being made for levels, and as soon as the lode is cut crosscuts will be started simultaneously from the several levels. This tract which adjoins the Champion property on the south carries the lay of the Baltic lode for over 1¼ miles, and the diamond-drill cores taken showed a highly mineralized formation. At the Baltic, sinking is going on in all shafts. No. 2, the southerly opening, is down 1200 ft.; No. 3, 1600 ft.; and No. 4, 1500 ft. At No. 5 shaft, which is about 1200 ft. south of the Atlantic boundary, sinking is going on below the 13th level, and drifting from that level is being carried on toward the Atlantic. Development at this point will be watched with interest for if the copper continues north it will mean much to the Atlantic company. The new steel shaft house at No. 3 shaft will soon go into commission. This is of the cylindrical type, and has a capacity of about 1200 tons. The crushers are operated electrically and everything tends to enhance the economical handling of rock. As depth is obtained a better copper content of the rock at the Trimountain is found; this is especially the case in the ends of the property, at No. 1 shaft, which adjoins the Champion and at No. 4 adjoining the Baltic. At the Champion the fourth permanent hoisting plant is being rapidly assembled, and should be ready to go into commission May 1.

Mass—The ledge has been reached in the trenches which are being opened on the southeast corner of section 7. Two diamond-drill holes, put down in close proximity to the Great Eastern sandstone and in line with the Lake strike, showed a favorable copper-bearing formation and it is on the site of these holes that the trenching is being done.

Minnesota

Great Northern Iron Ore Lands—The trustees report that they hold 65,091 acres, of which 1597 acres had been leased prior to Dec. 6, 1906, to various parties. On that date 39,296 acres—35,906 owned in fee and 3390 under lease—were leased to the Great Western Mining Company, a subcompany of the United States Steel Corporation. Under the old leases 3,307,244 tons of iron ore were mined in 1907. The terms of the lease to the Great Western company provide for the mining and shipment of at least 1,500,000 tons of ore during the year 1908, and for an additional 750,000 tons in each year thereafter, until the total annual amount mined and shipped shall reach 8,250,000 tons in 1917. The royalty to be paid is based upon the quality of the ore mined. Ore containing 59 per cent. of metallic iron is the unit on which all royalties are computed. The lease fixes the royalty for each ton of such ore delivered at the dock for 1907 at $1.65. The royalty rises or falls 4.82c. for each increase or decrease of 1 per cent. in the amount of metallic iron contained in the ore. This makes the minimum payment for the year 1907, $1.1680 per ton of ore carrying 49 per cent. of iron, the lowest grade, and the maximum $1.9874 per ton of ore carrying 66 per cent. of iron. On all intermediate grades the royalty is fixed by this sliding scale. These royalties increase 3.4c. per ton annually during the life of the lease. Ore containing 49 per cent. of metallic iron is fixed as the minimum merchantable standard, but if ores of lower grade than this are shipped, the lessees pay a minimum royalty thereon of $1.10 per ton. These royalties include the cost of handling and delivery, sorting, rail transportation and dockage. All these charges amounting at the present time to 80c. per ton, are paid by the trust out of the royalty receipts. The lessees of the mines deliver the ore at the nearest convenient point to the Great Northern and it is re-delivered to the lessees at the docks at Superior, Wis. If there is any such deficiency in shipments, royalty must be paid the same as if the ore had been mined and shipped, and this royalty is fixed at the basic rate of $1.65 per ton for the first year and 3.4c. per ton additional for each year succeeding, less the transportation, dockage and other charges. The fixed minimum revenue from royalties as provided by the lease for each year is thereby secured; but any such deficiency payment may be credited against the surplus shipment of any subsequent year when more than the minimum amount stipulated for that year shall be shipped. The Great Western Mining Company pays all taxes on the properties and guarantees the trust against labor and all other liens. Full protection is afforded by a provision that title to the ore does not pass to the lessees until it is delivered at Superior, Wis., and all the obligations relating thereto have been discharged. To insure immediate development, the lease requires, under penalty of forfeiture, exploration first of the lands held under leases, and then of fee lands, with not less than 40 drills, until fully covered. At least five holes must be sunk in each 40-acre tract, and where orebodies are found, the extent of every such orebody must be determined. The lessee has fulfilled these requirements, over 50 drills being operated upon the lands in question. Large bodies of ore have been discovered upon lands not heretofore explored, and the results of the work have been very satisfactory.

Missouri

ST. FRANCOIS COUNTY

Doe Run Lead Company—The quarterly dividend has been reduced to 1 per cent. from the former 1½ per cent. Work on the new mill at Flat River has been started again. It was discontinued last fall.

ZINC-LEAD DISTRICT

Cameron Land—The new 150-ton mill erected by D. Cameron & Son on their land north of Joplin has been completed. A shaft 146 ft. deep has been sunk at the mill. Dirt running about 8 per cent. is to be worked.

Green & Roden—The new $23,000 mill on this land at Granby has been destroyed by fire and is a total loss. The mill was a new one of 250 tons capacity and had never been run. The fire is believed to have been of incendiary origin, as there was no fire in the mill. A new plant will be erected at once.

Herald—This company at Cave Springs, which recently consolidated with the Old Apple Tree Mining Company, has shut down its mill to install the new Foust jigs in place of the old type. This is the first installation of the new jig near Joplin.

Taylor Land—The 40-acre tract of Mrs. Taylor on Turkey creek, north of Joplin, has been leased to Jacobs & Co., of Baxter Springs. The Bob Moore shaft in this lease was once a heavy producer.

Montana

BUTTE DISTRICT

Tuolumne—Drifting on the north vein on the 1000-ft. level has opened a body of ore 4 ft. wide, carrying from 3 to 7 per cent. copper. Drifting is also continuing on the south vein. The company is preparing to install a new hoisting engine.

Butte-Milwaukee—The company has resumed work on the Colonel Sellers claim, and is getting ready to place a large new hoist, after which sinking will be resumed.

Butte Central—Progress is being made toward settling up the litigation and getting the affairs of the company in condition for a re-organization. The capital will be reduced from $7,000,000 to $2,500,000.

Nevada

ESMERALDA COUNTY—GOLDFIELD

Ore Production—Deliveries of ore for the week ended March 26 were: To Western Ore Purchasing Company from Rogers Syndicate, 205; Sandstorm, 120; Florence Annex, 55; Kerns lease, 59; Daisy, 51; Florence, 5; total, 495 tons. To Nevada-Goldfield Reduction Works, from Jumbo, 254; Rogers Syndicate, 162; Little Florence, 133; Mohawk, 120; Combination Fraction, 90; New Western Reduction, 36; Daisy, 24; Von Polenz, 20; total, 839 tons. Combination Mill, 685 tons. This makes a total of 2019 tons for the week.

Little Florence—A new orebody has been cut in a drift on the 400-ft. level. Work is being rushed between that and the 500-ft. level. The company has added to its property by a lease of the southern half of the Combination Fraction, on which it will sink a shaft 1000 ft. deep.

Mohawk-Red Top—In this lease, on Goldfield Consolidated property, a body

of shipping ore has been cut on the 420-ft. level. The extent is not yet determined.

Rogers Syndicate—This concern has just paid its first dividend, amounting to $50,000 in all.

NYE COUNTY—BULLFROG

Action is being taken to secure a custom mill for Bullfrog. A considerable sum has been secured, and a company will be organized.

Bullfrog West Extension—The directors have decided to push development work to the westward.

Diamond Queen—In the Biddlecomb-Culver lease a 6-ft. vein of good ore has been struck, and is now being drifted on.

Sparling Mill—Cyanide tanks are being added to this mill.

NYE COUNTY—TONOPAH

Ore Shipments—Shipments by rail for the week ended March 26 were: MacNamara, 104; Tonopah Extension, 99; West End, 60; total, 263 tons. Deliveries to mills were: Tonopah company, 2050; Montana-Tonopah, 1100; Belmont, 660; Midway, 180; Jim Butler, 100; total, 4090 tons. Total production for the week, 4353 tons.

Jim Butler—But little work is being done underground and consequently the working force has been reduced. Satisfactory progress is being made in the excavation for the foundation of the machinery, which is to be placed at the Stone Cabin shaft, through which all the future work will be done, the company having determined to concentrate efforts on this block of ground. All work through the Wandering Boy shaft has been temporarily suspended. Just as soon as the surface work is completed and the machinery ready to run, a full force of miners will be put on and systematic development work carried on.

MacNamara—Another body of good ore has been found in a crosscut on the 400-ft. level, and work is being pushed to determine its extent.

West End—Ore is being opened up in the western part of the mine, nearly 800 ft. from the old shaft. The new hoist, 600 ft. west from the old shaft, is now in use to raise ore.

North Carolina

ALEXANDER COUNTY

A discovery of asbestos is reported at Taylorsville, near the Iredell county line. Its extent is not yet known.

LINCOLN COUNTY

Piedmont Tin Mining Company—This company is taking out about 20 tons of ore daily. This yields from 700 to 1000 lb. concentrates. These are shipped to England for treatment. The mine is three miles from Lincolnton. S. R. Atkinson, Atlanta, Ga., is president of the company; John H. Furman is consulting engineer.

Ohio

BELMONT COUNTY

River & Rail Coal Company—President H. A. Kuhn announces that on April 15 the general offices of this company will be removed from Bellaire, Ohio, to Pittsburg, occupying offices in the Fulton building. George Paull will be in active charge of the Pittsburg offices as manager of sales; he has been connected with this company for the past five years. J. J. Roby, general manager of the Roby Coal Company, of Cleveland, has been engaged as manager of mines with headquarters at Bellaire, where the operating department will be maintained. The company owns 31,000 acres of the Pittsburg No. 8 seam of coal, having eight miles of frontage on the Ohio. Its mines are located on the Cleveland & Pittsburg division of the Pennsylvania company; on the main line of the Baltimore & Ohio west, and on the Ohio river.

Oklahoma

OTTAWA COUNTY

New State Mining Company—This company has started pumping at its mine and will commence production soon.

South Dakota

CUSTER COUNTY

Saginaw—Twenty stamps are to be placed in the mill with a 50-ton cyanide annex and active operations will be commenced during the early summer. The diamond drill has disclosed several new orebodies in the lower levels.

LAWRENCE COUNTY

Dividend—In the quartzite formation a strike has been made and the mother lode is believed to be located. The property is leased to John Wiegand.

Wasp No. 2—Extensive repairs are being made in the 40-stamp mill, and the electric power will be used to transport the ore from mine to mill.

PENNINGTON COUNTY

Bengal Tiger—A deal is on for the sale of the property, near Hill City, to New York men. It is a gold property, worked successfully years ago.

Canton—Returns from a carload of ore shipped from the new strike in a 3-ft. vein show $28 per ton gold. The ore is smelting grade and is crushed first in the 40-ton Chilean mill on the property. Shipments will be made to Omaha.

Gopher—Minnesota owners are preparing to reopen the five-stamp mill on ore newly encountered. The property is north of Hill City.

J. R.—Superintendent Crocker is about to resume work in the five-stamp mill. He has a vein of gold ore 14 ft. wide exposed and partly developed.

Montana Mining Company—A large acreage near Rochford has just been purchased and preparations are being made to resume work after 10 years practical idleness. The ledges show free gold, and the mill will be equipped with new machinery.

Tennessee

Shipments of Tennessee phosphates over the Louisville & Nashville road in 1907 were 626,682 tons, of which 102,996 tons were for export, and 523,686 tons for domestic points. The increase over 1906 was 136,000 tons.

HAMILTON COUNTY

National Bauxite Company—This company is making arrangements to resume work on its bauxite mine on Mission ridge, near Chattanooga. C. D. McCollister, Philadelphia, is manager; S. R. Hampton, Chattanooga, is president.

Utah

JUAB COUNTY

Crown Point—Development work is progressing steadily in this property. The shaft is down 350 ft., and drifting is in progress on the 300 level.

May Day—A small force of men has been put to work in this property preparing for a resumption of ore shipments.

Tintic Shipments—Ore from Tintic mines shipped during the past week was 49 carloads, the contributing mines being: Centennial Eureka, 42; Eureka Hill, 6; Bullion Beck, 1 car.

Tetro—A vigorous campaign of development has been inaugurated, the company having recovered from the financial difficulties brought on by the absconding of a former officer.

Virginia

WISE COUNTY

Stonega Coal and Coke Company—This company, which already has eight producing mines and a number of coke ovens, has begun work on 360 additional coke ovens at Croosbrook, two miles from the main plant at Stonega.

West Virginia

MARSHALL COUNTY

Riverside Coal and Coke Company—This company has taken an option on 164 acres at Round Bottom, on the Ohio, near Moundsville. Work will soon be begun on the property, opening a mine and erecting a tipple.

RALEIGH COUNTY

Pemberton Coal and Coke Company—This new company has leased a tract of

2600 acres of coal lead near Pemberton, and is preparing to open a mine.

Wisconsin

ZINC-LEAD DISTRICT

Mineral Point Zinc Company—This company is shipping from the plant at Mineral Point to its works at De Pue, Ill., 4000 tons of low-grade Western sulphide ores, mainly from Colorado, and assaying between 25 and 30 per cent. zinc. Of this crude ore 560,900 lb. was shipped to De Pue during the past week; it will be calcined at De Pue, where the company is better equipped to make a special kind of sulphuric acid and is thus enabled to remove the ore there at a profit. The Mineral Point Zinc Company also shipped to De Pue during the week 382,700 lb. of high-grade roasted blende to be converted into spelter; this roasted ore is made from zinc concentrates produced in the Platteville district, but the tonnage had already been recorded when shipped. After extracting the sulphur from the low-grade Western ores at De Pue, the residue will be re-shipped to Mineral Point to be converted into zinc oxide. The company will not discontinue making acid at Mineral Point, however, and only a portion of the Western ores are being sent to De Pue.

Philippine Islands

BENGUET

Benguet Consolidated Mining Company—This company's stamp mill has been completed, and a steel pipe has been put in to replace the wooden flume. The cyanide plant has been improved by putting in agitators. About 2000 ft. of development has been completed, and a large body of ore is reported in sight. The tanks and other appliances were built from material obtained on the property, the iron work and machinery being furnished by the Joshua Hendy Machine Company, San Francisco.

Benguet Mining Association—This association has been organized at Baguio, with 40 members. The objects are the framing of local regulations, the arbitration of mining disputes, the prevention of wildcat schemes, the establishment of an information and labor bureau, the construction of roads and to provide for accurate information about the district.

CAMARINES

Paracale Gold Dredging Company—This company's dredge has resumed work, after receiving thorough repairs. The gold saving is reported to be good. In addition a quantity of black sand has been saved for future treatment, in case experiment should prove it to be valuable.

San Mauricio—Work is now in progress on these placers, near Mabula. Gold was obtained at these mines in Spanish times.

MASBATE

Gold Bug—A cyanide plant is to be added to this mill, to work the tailings from the stamp-mill and amalgamating tables.

Canada

ONTARIO—COBALT DISTRICT

Ore Shipments—Shipments of ore for the week ending March 28 were as follows: Coniagas, 61,340 lb.; Cobalt Lake, 64,910; City of Cobalt, 127,970; Kerr Lake, (Jacobs) 63,010; La Rose, 140,000; McKinley-Darragh, 61,900; Nipissing, 63,230; Temiskaming, 121,600; Trethewey, 66,020; total 769,980 pounds.

Abitibi Location—This property in Lorraine township also known as the St. Denis, has been secured by a Birmingham, Ala., syndicate, which has organized the Big Fissure Mining Company, capitalized at $2,000,000. Joseph Heeley, who has had experience in Idaho is in charge. A crosscut will be run from the main shaft at the 150-ft. level to tap a narrow vein, 200 ft. distant, which carries native silver on the surface.

Badger—A considerable amount of leaf and native silver lately has been found in the 18-in. vein which at first showed no silver content. The wall rock also carries some silver in places.

ONTARIO—HASTINGS COUNTY

Deloro Smelter—This smelter is running steadily on Cobalt ores and has made a shipment, to London, Eng., of 2¼ long tons of silver bullion, valued at from $25,000 to $30,000.

Farnum—Heavy shipments of ore are being made from this iron mine. It is expected that about 50,000 tons will be shipped this season.

NOVA SCOTIA

Dominion Coal Company—The output for March was 344,000 tons, as against 212,000 tons for March, 1907. The totals for the first quarter of the year were 940,830 tons in 1908, against 707,280 tons last year.

Nova Scotia Steel and Coal Company—The output of coal for March was 57,404 tons, an increase of 4604 tons over February. The steel plant was active, the March output being 6200 tons of iron, 8592 tons of coke and 7200 tons of steel.

Mexico

AGUAS CALIENTES

Asientos Copper Company—This company has for the last month been prosecuting development, and is expected to resume shipments shortly. Ore carrying 13 per cent. copper besides some silver has been found in the Refugio workings.

CHIHUAHUA

Buenaventura—This mine in the Suhuayacan country is to have new hoisting machinery and a pump. A large amount of ore has been developed; 19 tons of picked rock yielded recently in an arrastre about $11,000.

Santa Barbara—This mine of the Rio Plata Mining Company, near Guazapares, in February produced shipping ore and concentrates to the value of $42,000. Slime-treatment machinery has been installed and the tailings are being stored for treatment by a cyanide plant which is under consideration.

Dolores Gold-Silver Mines Company—The Banco Minero received during the last week of March from this company 70 bars of bullion worth $135,000.

San Pedro—This mine at Naica is shipping 3000 tons of ore monthly to the smelters.

GUANAJUATO

Pinguico—The 145-meter level continues to show good ore. The mill is handling more than 200 tons daily.

JALISCO

Boca Ancha—A 50-ton concentrating plant has been completed at this property in the Parnaso district. The mill will be run by steam power at first, but concessions have been secured for a hydro-electric plant on the Parnaso river to furnish power for all purposes. After the concentrating plant is in operation, the erection of a cyanide annex will be begun.

NUEVO LEON

Compañia de Minerales y Metales—A rich strike of lead ore is reported from the property of this company at Minas Viejas, near Villaldama.

OAXACA

Guebeche—A plant with a daily capacity of 75 tons is to be erected for the treatment of the copper and zinc ores of this mine in the Ocotlan district.

Rosario—This mine in the Taviche district has been sold to a company formed in Montgomery, Alabama. A steel-gallows frame is to be set up and a three-compartment shaft sunk below the present depth of 260 ft.

ZACATECAS

La Bohemia Mining Company—This company has increased its holdings to 72 *pertenencias* and is said to be developing ore of shipping grades. The drifts on the San Pedro vein have been continued east and west, and a pump has been installed on a new level at 180 ft.

Australia

WESTERN AUSTRALIA

The total output of the Collie coalfield in 1907 was 149,794 tons. There were four companies operating in the field.

Metal, Mineral, Coal and Stock Markets

Current Prices, Market Conditions and Commercial Statistics of the Metals, Minerals and Mining Stocks

QUOTATIONS FROM IMPORTANT CENTERS

Coal Trade Review

New York, April 8—The troubles in the West seem to be in a fair way of settlement. Owing to the insistence of Mr. Lewis, the new president of the United Mine Workers, another conference is being held in Indianapolis today, and it appears quite probable that a general conference will be called to form a new interstate agreement. Meantime, the district meetings heretofore called are waiting to see the result. In Indiana the miners have agreed to continue work, pending a settlement, wages to be paid according to the new agreement.

The Southwestern conference, which broke up last week without an agreement, has been assembled again at Kansas City.

The coal-trade in the East is dull and quiet, and the usual spring business has not come forward as yet.

Coal Traffic Notes

Tonnage originating on Pennsylvania railroad lines east of Pittsburg and Erie, year to March 28, in short tons:

	1907.	1908.	Changes.
Anthracite	1,319,081	1,209,280	D. 109,801
Bituminous	9,196,623	8,093,033	D. 1,103,590
Coke	3,433,088	1,718,252	D. 1,714,836
Total	13,948,792	11,020,565	D. 2,928,227

Total decrease this year, 21 per cent. Decrease in coke, 50 per cent.

Anthracite shipments in March are reported at 4,766,158 long tons, a decrease of 469,656 tons, as compared with March, 1907. For the three months ended March 31, the shipments were, in long tons:

	1907. Tons.	1907. Per Ct.	1908. Tons.	1908. Per Ct.
Reading	2,890,392	19.2	2,734,146	18.4
Lehigh Valley	2,597,830	17.3	2,400,503	16.1
N. J. Central	1,888,592	12.5	1,859,752	12.5
Lackawanna	2,515,496	16.7	2,356,281	15.8
Del. & Hudson	1,508,313	10.0	1,702,599	11.5
Pennsylvania	1,402,590	9.3	1,428,594	9.6
Erie	1,595,778	10.6	1,732,719	11.6
N. Y., Ont. & W.	660,483	4.4	673,659	4.5
Total	15,059,474	100.0	14,888,253	100.0

Total decrease this year, 171,221 tons, or 1.1 per cent. The four leading companies show decreases, the others small gains.

New York

Anthracite

April 8—The hard-coal market is active since the reduction of 50c. per ton on prepared sizes, a week ago. All sizes, with the exception of buckwheat No. 2 are in demand and a large tonnage is being moved. In the small steam sizes dealers are cutting the circular price, but in prepared sizes there is no reduction. Prices now are as follows: Broken, $4.25; egg, stove and chestnut, $4.50; pea, $3.25@3.50; buckwheat No. 1, $2.75@3; buckwheat No. 2 or rice, $2.15@2.25; barley, $1.75; all f.o.b. New York harbor.

Bituminous

The soft-coal market has fallen into a state of lethargy and little business is being done. Throughout New England factories are idle or working on half-time and there does not seem to be a disposition on the part of consumers to place contracts at this time; indeed there are some consumers, who usually place their contracts about now, who declare that they will not do so until June or July.

In New York harbor trade is dull and good grades of steam coal may be bought for $2.60@2.65 per ton. Transportation from mines to tide and car supply are both up to all requirements. There is nothing new in the coastwise trade.

Birmingham

April 6—The production of coal in Alabama has been reduced by the shutting down of a few mines in the Pratt Mines division of the Tennessee company because of the blowing out of three or four furnaces and the steel plant at Ensley to make repairs. Announcement is made that mining prices in some sections of the State have been reduced from 57½ to 47½c. per ton. In the commercial mines there appears to be a little increased activity. The iron and steel corporations do not deal with the United Mine Workers at all. Almost every company regulates its own prices and mining regulations, some of them yet adhering to the pig-iron price basis.

There is no change in the coke situation. The Semet-Solvay By-Product Company, operating the coke-oven plants of the Tennessee company at Ensley, will provide for just twice as many coke ovens as are now in operation, erecting during this summer 240 new ovens. There is a strong demand for the by-products.

Chicago

April 6—Notwithstanding the suspension of mining, the consumer refuses to buy to any extent. He will take coal for his current needs, but he will not lay in any considerable stock. Domestic coals are naturally dull at this time of the year. Steam coals are dull because business is uncertain. As regards anthracite, consumer and retailer are waiting for the April prices to create a general lessening of demand after the first of the month's rush.

Lump and prepared sizes of Western coals sell for $1.75@2.25; run-of-mine brings $1.50@1.75, and screenings $1.35@1.45. Indiana coals command the preference in the market. Ohio coals are out of the market.

Smokeless is low, run-of-mine selling for $3@3.30, Pocahontas and New River, against $3.50@3.75 for lump or egg. Youghiogheny has a light market at $3.10 for ¾-in. steam and $3.20 for the same size gas coal.

Pittsburg

April 7—All the mines in the Pittsburg district are idle pending an adjustment of the mining rate. A committee of Pittsburg operators and miners are in Indianapolis attending a conference called by President T. L. Lewis, of the United Mine Workers. According to advices from that city arrangements have been made for an interstate conference to be held at Toledo on April 14, at which it is believed the old interstate agreement will be revived. The representatives of the Pittsburg Coal Company are urging an early settlement as they are anxious to get the mines started again. The independent operators are not particularly desirous of an early resumption. There is considerable coal in stock, and the idleness of the mines is not causing any inconvenience. Prices remain unchanged on the basis of $1.15 for mine-run coal at mine on contracts; but for current business the rate is 5c. a ton higher.

Connellsville Coke—The coke trade is dull and more ovens have been put on the idle list. For spot delivery furnace coke is selling at $1.60; on contract, from 10 to 20c. a ton higher. Foundry coke is $2.25@2.35, both spot and contract. The *Courier*, in its report for the week, gives the production in both fields at 139,663 tons. The shipments amounted to 6182 cars, distributed as follows: To Pittsburg, 2257 cars; to points west of Connellsville, 3443 cars; to points east of Connellsville, 482 cars.

Foreign Coal Trade

Imports of fuel into the United States for the two months are reported as follows:

	1907.	1908.	Changes.
Coal	315,510	316,638	I. 1,128
Coke	32,396	31,134	D. 1,262

The larger imports this year were 208,642 tons from Canada, and 77,427 from Australia; chiefly to the Pacific coast.

Exports of fuel from the United States for the two months ended Feb. 29, were, in long tons:

	1907.	1908.	Changes.
Anthracite	313,693	301,267	D. 12,426
Bituminous	1,135,759	1,223,600	I. 87,841
Total coal	1,449,452	1,524,867	I. 75,415
Coke	129,967	130,966	I. 999

Of the coal exports Canada took this year 292,022 tons anthracite and 697,063 bituminous; 989,085 tons in all, against 972,535 last year.

Iron Trade Review

New York, April 8—Little advance has been made, and the markets continue in much the same condition as last reported. For pig iron the demand is still irregular and mainly for early deliveries. More cutting of prices is reported, mainly in Southern iron, and there is evidently some competition for what business is going. In finished material there seem to be more building projects coming forward, but few of them have yet reached the contracting stage. Structural material, however, is the most active section of the market. Business generally is of a retail character. The railroads continue largely out of the market.

Iron and Steel Exports—Exports of iron and steel, including machinery, from the United States for February, and the two months ended Feb. 29, are valued as below by the Bureau of Statistics of the Department of Commerce and Labor:

	1907.	1908.	Changes.
February	$13,946,042	$14,069,249	I. $ 123,207
Two months	28,273,978	27,713,077	D. 560,901

Leading items of export for the two months, in long tons:

	1907.	1908.	Changes.
Pig Iron	12,829	4,222	D. 8,607
Billets, ingots & blooms	16,518	27,061	I. 10,543
Bars	16,217	9,499	D. 6,718
Rails	47,328	25,234	D. 22,094
Sheets and plates	19,312	16,480	D. 2,832
Structural steel	18,162	20,354	I. 2,192
Wire	24,906	23,514	D. 1,392
Nails and spikes	8,387	7,975	D. 412

A decrease is shown in nearly all these items.

Iron and Steel Imports—Imports of iron and steel, including machinery, from the United States for February and the two months ending Feb. 29, are valued as follows:

	1907.	1908.	Changes.
February	$3,020,986	$1,697,525	I. $1,323,461
Two months	6,317,048	3,764,291	I. 2,552,757

Leading items of imports for the two months, long tons:

	1907.	1908.	Changes.
Pig iron	98,987	30,521	D. 68,466
Scrap	3,551	1,076	D. 2,475
Ingots, blooms, etc.	3,294	1,188	D. 2,106
Bars	5,752	8,009	I. 2,257
Wire-rods	2,812	2,067	D. 748
Tin-plates	5,381	10,139	I. 4,758

The only considerable increase was in tin-plates.

Iron Ore Movement—Exports and imports of iron ore in the United States for the two months ended Feb. 29, are reported as follows, in long tons:

	1907.	1908.	Changes.
Exports	1,645	10,984	I. 9,339
Imports	188,899	90,134	D. 98,765

Imports of manganese ore for the two months were 34,431 tons in 1907, and 53,713 tons in 1908; increase, 19,282 tons.

Birmingham

April 6—The quotations are still between $12 and $13 per ton, No. 2 foundry, and the make is about holding its own in the Birmingham district. The Alabama Consolidated Coal and Iron Company will have one of the Gadsden furnaces making iron steadily before the middle of the week. The Tennessee Coal, Iron and Railroad Company has two of its blast furnaces at Ensley shut down for re-building, two have fires under them, while but two are in operation.

The big cast-iron pipe plant of the United States Cast Iron Pipe and Foundry Company, in Bessemer, is again in full operation, and it is understood that there is plenty of steady work ahead. The Central Foundry Company, at Bessemer, has its plant almost in full operation. The pipe plants at North Birmingham are giving steady employment to a good sized force.

Chicago

April 6—Pig iron continues to be but lightly in demand, but the tendency is toward increasing sales, though the progress is slow. From a minimum of 200- to 300-ton lots the market has increased until 300- to 500-ton lots are not exceptional. Southern iron continues to lead, the lowest price quoted being $12 Birmingham, or $16.35 Chicago. On most sales, $12.50 represents the market ($16.85 Chicago). The sales that are now being made are chiefly of Southern. Northern sells for $17@17.50, with the demand limited.

The demand for iron and steel products is increasing gradually. Structural steel, plates, sheets and other finished products are in greater demand. Coke is still dull, the best Connellsville being obtainable at $5, with West Virginia at the same figure.

Philadelphia

April 8—Conditions are still more unsettled than last week because of new complications in the West and South involving marked concessions from recent low quotations. Large transactions half-assured a week ago have vanished. The combination in pig iron, if it is entitled to be regarded as such, is helpless in the present situation, as there are enough independent or outside producers to supply all the iron actually needed.

Steel Billets—The drop in billets is as much a drop as though not hidden under freight rates. The reduction is virtually $1.50, but there is not such an increase in the volume of business as might be expected.

Merchant Bars—Bar iron is being shaded in sympathy with pig, and mill representatives are seeking business.

Sheets—A reduction has been made on large orders for sheets, but not in the retail trade.

Merchant Steel—There has been quite an advancement in orders to mills in this territory.

Pipes and Tubes—Decided concessions have been made in pipe, with the result that a few long pending orders have gone to mill.

Plates—Plates have felt the effects prevalent in other branches of the trade. Small orders are the rule. Considerable new work is in sight, but manufacturers do not feel sure of getting it at once.

Structural Material—The cut in steel for constructional purposes will in all probability bring along considerable business. The reduction has been too recent to say much about it.

Scrap—A good deal of scrap has been purchased and contracted for. Prices have been reduced on heavy steel. The railroads are accumulating stock, but are holding it at higher prices than dealers are willing to pay.

Pittsburg

April 7—The second quarter opened with a better tone in the iron and steel markets, and there were indications of an improvement. This week, however, conditions do not seem to be so favorable. Buying in different lines continues to be for immediate requirements, and no business of any consequence has been placed for over a week. The only branches that are nearly normal are tin-plate and wire. The American Sheet and Tin Plate Company has 202 of its 242 tin mills going. In the sheet branch the company is running to over 50 per cent. of capacity, and the wire mills are being operated to about 60 per cent. of capacity. The Carnegie Steel Company put a number of additional mills in operation at its Homestead plant and the big steel works are running nearly to capacity. The Edgar Thomson rail plant, however, is not being operated more than two days a week, and the orders rolled are chiefly for foreign shipment. The Republic Iron and Steel Company is still operating but 50 per cent. of its capacity. Prices are being maintained in all finished lines.

Pig Iron—The pig-iron market seems stronger, although sales have been limited. One interest that has a practical monopoly on chill-cast bessemer sold 500 tons at $18.25, at furnace. The bessemer average

for March was announced at $16.96¼, Valley furnaces, or 3¾c. less than February and $1.13¾ less than January. No sales have been made so far this month at less than $17. Shading of No. 2 foundry has stopped and $15.50, at furnace, is the lowest quotation. Basic iron is quoted at the same price, and gray forge continues at $14.50. A number of contracts for malleable bessemer are pending, and may be placed if the furnaces quote less than $16, Valley. Some sales of Southern No. 2 foundry were made in this market on the basis of $12, Birmingham.

Steel—There is little new business going in billets, and the mills adhere strictly to the price of $28, Pittsburg, and pay half the freight. A finishing mill is in the market for a large tonnage of billets, but will only buy if the price named is $26, delivered. This would make the rate $24.50, Pittsburg. Plates remain at 1.70c., and merchant-steel bars at 1.60c.

Sheets—The market is quiet and prices unchanged; black sheets, 2.50c., and galvanized, 3.55c. for No. 28 gage.

Ferro-manganese—The market continues strong at $45@45.50 per ton.

Metal Market

NEW YORK, April 8.

Gold and Silver Exports and Imports

At all United States Ports in Feb. and year.

Metal.	Exports.	Imports.	Excess.
Gold:			
Feb. 1908..	$ 1,967,597	$ 2,802,431	Imp. $ 834,834
" 1907..	1,127,059	3,329,867	" 2,202,808
Year 1908..	2,411,797	13,734,964	" 11,323,167
" 1907..	3,577,031	6,600,372	" 3,023,341
Silver:			
Feb. 1908..	4,108,774	3,409,777	Exp. $698,997
" 1907..	4,843,970	3,721,988	" 1,121,982
Year 1908..	8,256,918	7,031,651	" 1,225,267
" 1907..	9,610,935	7,379,029	" 2,231,906

Exports from the port of New York, week ended April 4: Gold, $18,883, chiefly to London. Imports for the week: Gold, $485,200, from Cuba, Central America and South America; silver, $22,205, from the West Indies.

Specie holdings of the leading banks of the world April 4 are reported as below, in dollars:

	Gold.	Silver.	Total.
Ass'd New York	.....	.....	$281,926,200
England.....	$198,614,240	.....	198,614,240
France.....	553,247,265	$180,345,220	733,592,485
Germany.....	150,600,000	62,415,000	213,015,000
Spain.....	77,550,000	131,455,000	209,005,000
Netherlands....	38,479,500	22,210,500	60,690,000
Belgium.....	20,110,000	10,055,000	30,165,000
Italy.....	182,000,000	22,400,000	204,400,000
Russia.....	570,565,000	34,060,000	604,625,000
Aust.-Hungary.	233,260,000	64,765,000	298,025,000
Sweden.....	19,495,000	.....	19,495,000
Norway.....	7,500,000	.....	7,500,000
Switzerland....	16,880,000	.....	16,880,000

The New York banks do not separate gold and silver. The foreign statements are from the *Commercial and Financial Chronicle* of New York.

The total silver bought by the United States Mint in March was 665,000 oz. Highest price paid, 56.340c.; lowest, 55.649; average, 55.879c. per oz., delivered.

April 3, a purchase was made of 100,000 oz. at 55.506c., delivered.

Silver Market

SILVER AND STERLING EXCHANGE.

Apr.	Sterling Exchange.	Silver. New York, Cents.	Silver. London, Pence.	Apr.	Sterling Exchange.	Silver. New York, Cents.	Silver. London, Pence.
2	4.8650	55⅛	25⅛	6	4.8645	55⅛	25 7/16
3	4.8655	55⅛	25 7/16	7	4.8650	55	25⅜
4	4.8650	55⅛	25 7/16	8	4.8650	54⅞	25 5/16

New York quotations are for fine silver, per ounce Troy. London prices are for sterling silver, 0.925 fine.

Messrs Pixley & Abell report silver shipments from London to the East for the year to March 26:

	1907.	1908.	Changes.
India.....	£3,860,910	£1,753,238	D. £2,107,672
China.....	.....	501,400	I. 501,400
Straits.....	172,550	78,270	D. 94,280
Total.....	£4,033,460	£2,332,908	D. £1,700,552

Receipts for the week, £9000 from New Zealand, £6000 from Chile, £12,000 from the West Indies, £244,000 from New York; £271,000 in all. Exports, £143,000 to India

Other Metals

Apr.	Copper. Lake, Cts. per lb.	Copper. Electrolytic, Cts. per lb.	Copper. London, £ per ton.	Tin. Cts. per lb.	Lead. Cts. per lb.	Spelter. New York, Cts. per lb.	Spelter. St. Louis, Cts. per lb.
2	13 @13¼	12¾ @13	59¾	31½	3.90 @4.00	4.65 @4.70	4.50 @4.55
3	13 @13⅛	12¾ @13	59	32	3.90 @4.00	4.60 @4.65	4.45 @4.50
4	13 @13⅛	12¾ @13	.....	32	3.90 @4.00	4.60 @4.65	4.45 @4.50
6	12⅞ @13⅛	12¾ @12⅞	59⅛	31⅞	3.90 @4.00	4.60 @4.65	4.45 @4.50
7	12⅞ @13⅛	12¾ @12⅞	59	31¼	3.90 @4 00	4.60 @4.65	4.45 @4.50
8	12⅞ @13⅛	12¾ @12⅞	58⅞	31	3.90 @4.00	4.60 @4.65	4.45 @4.50

London quotations are per long ton (2240 lb.) standard copper, which is now the equivalent of the former g.m.b's. The New York quotations for electroytic copper are for cakes, ingots or wirebars, and represent the bulk of the transactions made with consumers, basis, New York, cash. The price of cathodes is 0.125c. below that of electrolytic. The quotations for lead represent wholesale transactions in the open market. The quotations on spelter are for ordinary Western brands; special brands command a premium.

Copper—The market continues in a lethargic condition. Consumers both here and in Europe have shown no particular interest, except for one or two inquiries today, and such business as has been transacted has been of a retail character at slightly lower prices. There have been reports of closing of the mints by the Chinese Government and consequent cancellations of purchases for Chinese account at a considerable sacrifice. There is no reliable information on the quantities involved. The close is uncertain at 12⅞ @13⅛ for Lake copper; 12¾@12⅞ for electrolytic in ingots, cakes and wirebars. The average of the week at which business has been done in casting copper is 12⅜@12⅝ cents.

The Standard market in London has been rather listless and moved within narrow limits, closing unchanged from last week at £58 17s. 6d. for spot, £59 7s. 6d. for three months.

Refined and manufactured sorts we quote: English tough, £62 10s.@63 10; best selected, £63@63 10; strong sheets, £74@75.

Exports of copper for the week from New York and Philadelphia were 2376 long tons. Our special correspondent gives the exports from Baltimore at 2080 long tons.

Copper Sheets and Wire—The base price for wire is 14¾c. per lb. For sheets, cold rolled or hard, 18c.; hot rolled or soft, 17c. per pound.

Tin—Heavy buying orders from this side infused a great deal of strength into the foreign market, which at one time reached £145 10s. for spot, £143 10s. for three months. After the demand was satisfied, a slight reaction took place, which is not unusual in such a speculative market as that for tin. The close is steady at £143 for spot, £142 for three months.

It is reported that the largest interest have placed good-sized orders for tin, and some of the smaller consumers have followed this lead, so that business was of larger volume than for some time past. At the close the market is quoted about 31 cents.

Visible stocks of tin April 1, long tons:

	In Store.	Afloat.	Total.
London.....	5,427	5,154	10,581
Holland.....	1,501	187	1,688
U. S., exc. Pacific ports	855	2,261	3,116
Total.....	7,783	7,602	15,385

Tin production in the Federated Malay States in the two months ended Feb. 29 is reported at 7994 long tons in 1907, and 9118 tons in 1908; an increase of 1124 tons.

Lead—The market is unchanged at 3.90 @4c., New York, but there is a stronger feeling.

The London market is lifeless, and at the close is somewhat lower at £13 18s. 9d. for Spanish lead, £14 1s. 3d. for English lead.

Spelter—The demand for this metal still leaves very much to be desired, and some tired holders who forced their metal for sale had to make sacrifices to find a market. The close is easy at 4.60@4.65c. New York, 4.45@4.50c., St. Louis.

The European market is somewhat firmer at £21 7s. 6d. for good ordinaries, £21 12s. 6d. for specials.

Zinc Sheets—The base price is $7 per 100 lb.—less discount of 8 per cent.—f.o.b. cars at Lasalle and Peru.

Antimony—The market, both here and abroad, is dead, the buying being only from hand to mouth. Quotations are 8¾ @9c. for Cookson's, 8⅝@8⅞c. for Hallett's, and 7⅞@8⅛c. for ordinary brands.

Aluminum—The current price for No. 1 ingots, in ton lots, is 33c. per lb. For rods and wire, No. 0000 to 10, base price is 38c. For sheets, No. 13 to 24, B. & S. gage, base price is 40c. Tubes, 1¼ to 3½ in., base 50c. Higher prices are charged for small lots.

Cadmium—The price is $1.25 f.o.b. Cleveland in 100-lb. lots. A higher price is asked for smaller lots.

Nickel—For large lots, New York, the chief producer quotes 45@50c. per lb. according to size and terms of sale. For small quantities, 50@65c., same delivery.

Quicksilver—New York quotations are $45 per flask for lots of 100 flasks or over, and $46 for smaller orders. San Francisco quotations are $44.50@45.50 for domestic orders; for export nominal, at about $1.50 lower. The London price is £8 5s. per flask, with £8 3s. 9d. quoted from second hands.

Platinum—The general inactivity has caused a further recession of 50c. per troy ounce during the past week. Prices are as follows: $26.50 for hard platinum, $24 for ordinary, and $17 for scrap.

Wisconsin Ore Market

Platteville, Wis., April 4—The highest price paid this week for zinc ore was $37 per ton on a basis of $36 per ton of 60 per cent. zinc. Lead ore sold at $25 per thousand for 80-per cent. lead.

Camps.	Zinc ore, lb.	Lead ore, lb.	Sulphur ore, lb.
Benton	205,670	.....	.....
Platteville	200,700	.....	.....
Mineral Point	176,500	.....	.....
Hazel Green	82,000	.....	.....
Livingston	80,000	.....	.....
Rewey	63,000	.....	.....
Linden	60,400	.....	.....
Total	868,270	.....	.....
Year to Apr. 4	17,104,770	1,087,285	79,800

The Mineral Point Zinc Company reentered the competitive field this week, buying low-grade zinc ores.

Missouri Ore Market

Joplin, Mo., April 4—The highest price paid for zinc was $39.50 on an assay base price of $33@36 per ton of 60 per cent. zinc, with the average price of all grades $33.38. The highest price of lead was $54, medium grades bringing $51@53, and all grades averaging $51.90 per ton.

The district seems to be adjusting itself to the present level of zinc and lead prices, and the greatest point has been the increased efficiency of employees. It has enabled the district to reach 72 per cent. of the average shipment for the first three months of last year. The January shipment was 77 per cent. of January last year; February, 63 per cent., and March, 86 per cent. of last year. More ore is being produced on single shifts now than was produced on double shifts by the same mills a year ago, with little change in the average run of ore milled.

Following are the shipments of zinc and lead from the various camps of the district for the week ending April 4:

	Zinc, lb.	Lead, lb.	Value.
Webb City-Carterville	3,666,780	600,840	$77,955
Joplin	1,849,530	252,680	38,936
Duenweg	832,860	86,340	16,402
Galena	776,170	43,250	14,319
Badger	610,040	73,230	12,578
Prosperity	203,050	146,430	7,258
Alba-Neck	318,020	.....	5,983
Aurora	311,390	7,990	5,181
Granby	290,000	22,000	3,500
Spurgeon	251,940	26,560	3,130
Quapaw-Baxter	.....	103,210	2,683
Zincite	116,860	12,890	2,263
Oronogo	113,110	9,100	1,855
Carthage	60,330	.....	1,116
Sarcoxie	63,270	.....	1,075
Peoria	77,490	1,930	1,017
Wentworth	45,270	.....	769
Totals	9,586,110	1,386,650	$196,020
14 weeks	121,861,550	17,386,410	$2,546,614
Zinc value, the week, $160,030; 14 weeks, $2,118,635			
Lead value, the week, 35,990; 14 weeks, 427,979			

Average ore prices in the Joplin market were, by months:

ZINC ORE AT JOPLIN.			LEAD ORE AT JOPLIN.		
Month.	1907.	1908.	Month.	1907.	1908.
January	45.84	35.56	January	83.58	46.88
February	47.11	34.92	February	84.58	49.72
March	48.66	34.19	March	82.75	49.90
April	48.24	.....	April	79.76	.....
May	45.98	.....	May	79.56	.....
June	44.82	.....	June	73.66	.....
July	45.79	.....	July	58.18	.....
August	43.22	.....	August	59.54	.....
September	40.11	.....	September	53.52	.....
October	39.83	.....	October	51.40	.....
November	35.19	.....	November	43.40	.....
December	30.87	.....	December	37.71	.....
Year	43.68	.....	Year	68.90	.....

Chemicals

New York, April 8—The market, as a whole, is easy, but certain chemicals, especially those used in agriculture, are more active.

Copper Sulphate—An active demand has set in and considerable stock has been sold. Prices remain at $5 per 100 lb. for carloads and $5.25 for smaller lots.

Exports of copper sulphate, two months ended Feb. 29, were 2,870,529 lb. in 1907, and 2,253,106 lb. in 1908; decrease, 617,428 lb. this year.

Nitrate of Soda—The market is firmer and the salt is in better demand. Prices remain unchanged at 2.40c. for all positions of 1908; 2.37½c. for 1909, and 2.32½c. for 1910. The 96 per cent. grade sells 5c. per 100 lb. higher.

The position of nitrate in the United States April 1 is reported by Mortimer & Wisner, New York, as follows, in long tons:

	1907.	1908.	Changes.
Stocks, Jan. 1	13,050	5,900	D. 7,150
Imports, 3 months	45,434	53,300	I. 7,866
Total Supplies	58,484	59,200	I. 716
Deliveries, 3 months	53,909	51,650	D. 2,259
Stocks, Apr. 1	4,575	7,550	I. 2,975
Afloat for U. S.	120,000	80,000	D. 40,000

Quantities afloat include all cargoes due at United States ports up to July 15.

Sulphur—It is officially announced by A. Ravaioli, commercial delegate to the Royal Italian Embassy, that there is no truth in the reports that an agreement to regulate the consumption and price of sulphur has been entered into by the Consorzio and the Union Sulphur Company. An official denial has also been made by the Union Sulphur Company.

Imports of sulphur and pyrites, two months ended Feb. 29, long tons:

	1907.	1908.	Changes.
Sulphur	3,770	8,069	I. 4,299
Pyrites	99,493	137,554	I. 38,061
App. total sulphur	43,567	63,091	I. 19,524

Exports of sulphur for the two months, 1352 tons in 1907, and 1228 in 1908; decrease, 124 tons.

Phosphates—Exports of phosphates, two months ended Feb. 29, long tons:

	1907.	1908.	Changes.
Crude	124,531	172,749	I. 48,218
Other	3,600	4,024	I. 424
Total	128,131	176,773	I. 48,642

The larger exports were to Germany, Great Britain and France.

Heavy Chemicals—Imports of heavy chemicals, two months ended Feb. 29, pounds:

	1907.	1908.	Changes.
Bleaching powder	21,046,401	14,230,318	D. 6,816,083
Potash salts	50,529,022	27,162,245	D. 23,366,777
Soda salts	3,901,474	1,821,116	D. 2,080,358

Exports of acetate of lime for the two months were 16,860,287 lb. in 1907, and 7,539,967 lb. in 1907; a decrease of 9,320,320 lb. this year.

Mining Stocks

New York, April 8—The general stock markets have been fairly firm but dull. Trading has been light, and yesterday the total sales were the smallest of the year, with only one exception. Business is largely professional. That there are favorable features in the situation is not to be denied, but they do not seem to affect the stock market, except in the general maintenance of prices.

The curb market has been dull, rather than weak. The copper stocks have been quiet, the Cobalt shares attracting most business. Yukon Gold has been flat.

Boston

April 7—The market has been dull and stupid; only slight changes have occurred during the past week. In spots there has been activity, but at slightly varying prices. The listing of Utah Copper and Boston & Corbin is to be noted; the former is on the regular list and the latter in the unlisted department. A two-point decline followed in Utah Copper the first day, which has been recovered since. Boston & Corbin was one of the curb specialties and closed at $12 tonight. Boston Consolidated has been under more or less continued pressure. No unfav-

orable reports have yet come to the surface.

Bingham reorganization has been modified. A new Maine company is to acquire the Bingham and the Eagle & Blue Bell, and to exchange upon the payment of $3.50 per share. The new company—the Bingham Mines Company—will also issue $600,000 in 6-per cent. five-year second-mortgage collateral trust bonds convertible at par.

The proposed consolidation of the Utah Copper, Nevada Consolidated, Cumberland-Ely, and perhaps others, is said to be progressing.

The curb has been fairly active and prices are well maintained, Yukon Gold being the exception.

STOCK QUOTATIONS

NEW YORK	Apr. 7
Name of Comp.	Clg.
Alaska Mine	¾
Amalgamated	59
Anaconda	37⅞
Balaklala	2⅛
British Col. Cop.	4½
Butte & London	....
Butte Coalition	20½
Butte Cop. & Zinc	....
Colonial Silver	....
Cum. Ely Mining	8¼
Davis Daly	3⅜
Dominion Cop	2
Douglas Copper	4¾
El Rayo	1⅜
Florence	4¼
Foster Cobalt	.60
Furnace Creek	.17
Giroux	3½
Gold Hill	1⅛
Grauby	....
Greene Gold	⅛
Greene G. & S	⅜
Greenw'r & D.Val.	.75
Guanajuato	2¼
Guggen. Exp.	155
Hanapah	....
McKinley Dar	.68
Micmac	4¼
Mines Co. of Am	1⅜
Mitchell Mining	⅞
Mont. Sho. C.	2⅜
Nev. Utah M. & S	4
Newhouse M. & S.	6¾
Nipissing Mines	6½
Old Hundred	½
Silver Queen	1.05
Stewart	⅞
Tennessee Cop'r	41⅞
Tri-Bullion	1⅛
Union Copper New	⅛
Utah Apex	4¼
Utah Copper	29⅜
Yukon Gold	4½

N. Y. INDUSTRIAL	
Am. Agri. Chem	16¾
Am. Smelt. & Ref.	68⅜
Am. Sm. & Ref., pf.	95
Bethlehem Steel	....
Colo. Fuel & Iron.	24¼
Federal M. & S., pf.	....
Inter. Salt	11
National Lead	55⅞
National Lead, pf.	....
Pittsburg Coal	....
Republic I. & S.	18⅜
Republic I. & S., pf.	69
Sloss-Sheffield	44½
Standard Oil	530
U. S. Red. & Ref.	....
U. S. Steel	34
U. S. Steel, pf	98¼
Va. Car. Chem	19¼
Va. I. Coal & Coke	....

ST. LOUIS	Apr. 4	
N. of Com.	High.	Low.
Adams	.40	.30
Am. Nettie	.04	.03
Center Cr'k	2.00	1.50
Cent. C. & C.	66.00	64.00
C.C. & C. pd.	76.00	75.00
Cent. Oil	100.00	95.00
Columbia	4.00	3.00
Con. Coal	19.00	16.00
Doe Run	125.00	110.00
Gra. Bimet.	.25	.20
St. Joe	14.00	12.00

BOSTON	Apr. 7
Name of Comp.	Clg.
Adventure	‡2
Allouez	‡25
Am. Zinc	....
Arcadian	3¾
Atlantic	‡9
Bingham	.87
Boston Con	12⅛
Calumet & Ariz	101
Calumet & Hecla	625
Centennial	‡21¼
Con. Mercur	‡.35
Copper Range	65¼
Daly-West	8¾
Franklin	7
Greene—Can	8¾
Isle Royal	‡18½
La Salle	13½
Mass	2¾
Michigan	‡11
Mohawk	‡48
Mont. C. & C.	‡ ¾
Novada	11⅝
North Butte	53¼
Old Colony	.45
Old Dominion	35
Osceola	81½
Parrot	18
Quincy	‡80
Rhode Island	‡3
Santa Fe	‡1⅛
Shannon	11⅝
Superior	15½
Tamarack	61½
Trinity	13½
United Cop., com.	7⅛
U. S. Oil	9½
U. S. Smg. & Ref.	36½
U.S.Sm. & Re.,pd.	40
Utah Con	38
Victoria	3
Winona	5
Wolverine	125
Wyandotte	.70

*Ex. Div. †Ex. Rights. ‡Last quotation.

BOSTON CURB	
Ahmeek	57
Ariz. Com	18½
Black Mt.	4⅛
East Butte	4½
Hancock Con.	6¼
Keweenaw	4⅞
Majestic	1⅞
Raven	1⅜
Shawmut	.33
Superior & Pitts.	12⅜
Troy Man	.65

LONDON	Apr. 8		
Name of Com.	Clg.		
Dolores	£1	5s	0d
Stratton'sInd.	0	3	0
Camp Bird	0	13	9
Esperanza	1	6	3
Tomboy	1	8	9
El Oro	1	2	6
Oroville	0	11	6
Somera	..	..	.
Utah Apex	..	..	.
Ariz. Cop.,pfd.	..	..	.
Ariz. Cop.,def.	..	..	.

Cabled through Wm. P. Bonbright & Co., N.Y.

NEVADA STOCKS. April 8.
Furnished by Weir Bros. & Co., New York.

Name of Comp.	Clg.	Name of Comp.	Clg.
COMSTOCK STOCKS		Silver Pick	.21
Belcher	.11	St. Ives	.30
Best & Belcher	.60	Triangle	.07
Caledonia	.15	BULLFROG STOCKS	
Challar	.08	Bullfrog Mining	.06
Comstock	.23	Bullfrog Nat. B.	.10
Con. Cal. & Va	.39	Gibraltar	.10
Crown Point	.30	Gold Bar	.16½
Exchequer	.16	Homestake King.	.29
Gould & Curry	.08	Montgomery Mt.	.13
Hale & Norcross	.32	Mont. Shoshone C.	2.62½
Mexican	.98	Original Bullfrog.	.01
Ophir	2.42½	Tramp Cons	.18½
Overman	.07	MANHAT'N STOCKS	
Potosi	.01	Manhattan Cons.	.17
Savage	.30	Manhat'n Dexter.	.06
Sierra Nevada	.34	Jumping Jack	.03
Union	.37	Stray Dog	.04
Utah	.04	MISCELLANEOUS	
Yellow Jacket	.84	Golden Boulder	.06
TONOPAH STOCKS		Hayseed	.14
Belmont	1.06½	Lee Gold Grotto	.03
Extension	.75	Nevada Hills	2.62½
Golden Anchor	.02	Nevada Smelting.	1.25
Jim Butler	.30	Pittsburgh S. Pk.	1.02
MacNamara	.35	Round Mt. Sphinx	.27
Midway	.56		
Montana	1.70		
North Star	.12		
Tono'h Mine of N.	7.68½		
West End Con	.27		
GOLDFI'D STOCKS			
Adams	.05		
Atlanta	.24		
Booth	.20		
Columbia Mt.	.21		
Comb. Frac	.68		
Cracker Jack	.07		
Dia'dfield B. B. C.	.16		
Goldfield Belmont	.15		
Goldfield Con.	5.43½		
Goldfield Daisy	1.36		
Great Bend	.49		
Jumbo Extension	.33		
Katherine	.05		
Kendall	.18		
Lone Star	.09		
May Queen	.08		
Oro	.08		
Red Hill	.27		
Roanoke	.02		
Sandstorm	.35		

COLO. SPRINGS Apr. 4

Name of Comp.	Clg.
Acacia	....
Black Bell	....
C. C. Con	3¾
Dante	7½
Doctor Jack Pot	6¾
Elkton	51½
El Paso	32
Findlay	29
Gold Dollar	6
Gold Sovereign	....
Isabella	34
Index	....
Jennie Sample	2¾
Jerry Johnson	....
Mary McKinney	....
Pharmacist	3½
Portland	1.05
Un. Gold Mines	....
Vindicator	83
Work	....

New Dividends

Company.	Payable.	Rate.	Amt.
Am. Ag. Chem., pfd	Apr. 15	$3.00	$544,590
Anaconda	Apr. 15	0.50	600,000
Arizona, pref., A	Apr. 1	1.20	75,962
Bunker Hill & Sullivan	Apr. 4	0.25	75,000
Calumet & Arizona	Apr. 25	1.00	200,000
Central C. & C., com	Apr. 15	1.50	76,875
Central C. & C., pfd	Apr. 15	1.25	23,438
Copper Range Con	Apr. 1	1.00	383,781
Florence (Goldfield)	Apr. 1	0.10	125,000
Gen. Chem ical,pfd	Apr. 2	1.50	150,000
Guggenheim Exp.	Apr. 7	2.50	262,500
Inter. Nickel, pfd	May 1	1.50	131,123
Nipissing	Apr. 20	0.15	180,000
N. S. St. & Coal, com	Apr. 15	1.50	74,814
N. S. St. & Coal, pfd	Apr. 15	2.00	20,600
Penn. Salt Mfg.	Apr. 15	3.00	180,000
United States, com.	Apr. 15	0.50	175,466
United States, pfd	Apr. 15	0.87½	425,114
Utah Con	Apr. 15	0.50	150,000
Utah (Fish Springs)	Apr.	0.03	3,000
Va. Car. Chem., pfd	Apr. 15	2.00	360,000
Westmoreland Coal	Apr. 1	5.00	150,000
Wolverine	Apr. 1	5.00	300,000
Work	Apr. 4	0.01	15,000

Assessments

Company.	Delinq.	Sale.	Amt.
Blackjack Con., Utah	Feb. 20	Mar. 16	$0.03
Blue Bell, Utah	Feb. 15	Apr. 15	0.01
Butte & Yerrington, Nev.	Mar. 25	Apr. 16	0.02
Caledonia, Nev.	Mar. 10	Apr. 1	0.10
Century, Utah	Apr. 14	May 14	0.02
Champion, Cal.	Apr. 2	Apr. 22	0.50
Con. Imperial, Nev.	Mar. 11	Apr. 2	0.01
Duleek, Cal.	Mar. 6	Mar. 23	0.05
Eastern & Western, Utah	Mar. 16	Apr. 6	0.01
Exchequer, Nev.	Feb. 27	Mar. 19	0.05
Hannapah, Utah	Feb. 6	Mar. 10	0.01
Jenny Lind, Cal.	Mar. 10	Mar. 26	0.02
Julia, Nev.	Feb. 24	Mar. 18	0.03
Quincy, Jr., Utah	Mar. 21	Apr. 20	0.02
Scottish Chief, Utah	Mar. 18	Apr. 10	0.01
Skylark, Utah	Mar. 27	Apr. 14	0.01
Sierra Queen, Cal.	Mar. 15	Apr. 3	0.02
Trumbull Oil, Cal.	Feb. 24	Mar. 24	0.01
Union Con., Nev.	Mar. 2	Mar. 26	0.10
Western Mines, Nev.	Mar. 16	Apr. 23	0.01½

Monthly Average Prices of Metals

AVERAGE PRICE OF SILVER

Month.	New York.		London.	
	1907.	1908.	1907.	1908.
January	68.673	55.678	31.769	25.738
February	68.835	56.000	31.852	25.855
March	67.519	55.365	31.325	25.570
April	65.462	.....	30.253	.....
May	65.981	.....	30.471	.....
June	67.090	.....	30.893	.....
July	68.144	.....	31.366	.....
August	68.745	.....	31.637	.....
September	67.792	.....	31.313	.....
October	62.435	.....	28.863	.....
November	58.677	.....	27.154	.....
December	54.565	.....	25.362	.....
Year	65.327	.....	30.188	.....

New York, cents per fine ounce; London, pence per standard ounce.

AVERAGE PRICES OF COPPER

	NEW YORK.				LONDON.	
	Electrolytic		Lake.			
	1907.	1908.	1907.	1908.	1907.	1908.
January	24.404	13.726	24.825	13.901	106.739	62.386
February	24.869	12.905	25.236	13.098	107.356	58.786
March	25.065	12.704	25.560	12.875	106.594	58.761
April	24.224	.....	25.260	.....	98.625	.....
May	24.048	.....	25.072	.....	102.375	.....
June	22.665	.....	24.140	.....	97.272	.....
July	21.130	.....	21.923	.....	95.016	.....
August	18.356	.....	19.255	.....	79.679	.....
September	15.565	.....	16.047	.....	68.375	.....
October	13.169	.....	13.551	.....	60.717	.....
November	13.391	.....	13.870	.....	61.226	.....
December	13.163	.....	13.393	.....	60.113	.....
Year	20.004	.....	20.661	.....	87.007	.....

New York, cents per pound. Electrolytic is for cakes, ingots or wirebars. London, pounds sterling, per long ton, standard copper.

AVERAGE PRICE OF TIN AT NEW YORK

Month.	1907.	1908.	Month.	1907.	1908.
January	41.548	27.380	July	41.091	.....
February	42.102	28.978	August	37.667	.....
March	41.313	30.577	September	36.689	.....
April	40.938	.....	October	32.620	.....
May	43.149	.....	November	30.833	.....
June	42.120	.....	December	27.925	.....
			Av. year	38.166	.....

Prices are in cents per pound.

AVERAGE PRICE OF LEAD

Month.	New York.		London.	
	1907.	1908.	1907.	1908.
January	6,000	3.691	19.828	14.469
February	6,000	3.725	19.531	14.250
March	6,000	3.838	19.703	13.975
April	6,000	.....	19.975	.....
May	6,000	.....	19.688	.....
June	5,760	.....	20.188	.....
July	5,288	.....	20.350	.....
August	5,250	.....	19.063	.....
September	4.813	.....	19.775	.....
October	4.750	.....	18.531	.....
November	4.376	.....	17.281	.....
December	3.658	.....	14.500	.....
Year	5.325	.....	19.034	.....

New York, cents per pound. London, pounds sterling per long ton.

AVERAGE PRICE OF SPELTER

MONTH.	New York.		St. Louis.		London.	
	1907.	1908.	1907.	1908.	1907.	1908.
January	6.732	4.513	6.582	4.363	27.125	20.563
February	6.814	4.788	6.664	4.638	25.938	20.875
March	6.837	4.665	6.687	4.527	26.094	21.075
April	6.685	.....	6.535	.....	25.900	.....
May	6.441	.....	6.291	.....	25.563	.....
June	6.419	.....	6.269	.....	25.469	.....
July	6.072	.....	5.922	.....	23.850	.....
August	5.701	.....	5.551	.....	21.969	.....
September	5.236	.....	5.086	.....	21.050	.....
October	5.430	.....	5.280	.....	21.781	.....
November	4.925	.....	4.775	.....	21.438	.....
December	4.254	.....	4.104	.....	20.075	.....
Year	5.962	.....	5.812	.....	23.771	.....

New York and St. Louis, cents per pound. London in pounds sterling per long ton.